POWER

Established 1884—McGraw-Hill Publishing Company, Inc.

ELY C. HUTCHINSON, *Editor*

VOLUME 75 FEBRUARY 2, 1932 NUMBER 5

Interfamily Purchasing

"It's a fact and I know it! The coal doesn't suit my boilers nor the steaming conditions at all. But the boss' son-in-law is vice-president of a coal mine. I can't specify the coal I want. I am told to take what I get."

This typical conversation one hears in numerous places and it applies to numerous other power plant necessities. It is the bane of the existence of the conscientious plant engineer or whosoever is responsible for the practical operation of plant equipment.

The practice of this kind of buying is subversive of the very root and branch of sound engineering practice. Not only does it beget irresponsibility and destroy individual pride of accomplishment in the operating men, but it takes away from the boss the right to criticize his men for failure to secure plant economies equal to those of his neighbor.

In these days of unremitting necessity for low-cost power he who winks at plant purchasing methods not based upon the soundest economies, irrespective of family ties, is living in a fool's paradise.

EDITORIALS

Speed Range for Ventilating Fans

Practices are sometimes established through use and accepted as standard without being critically studied. The generally accepted specification of fifty per cent speed range for motors driving ventilating fans in buildings is a case in point. Experience has shown that this is more than ample to meet the needs of most ventilating systems. How much it can be reduced and still be sufficient for a properly designed ventilating system is not generally known.

Where direct-current motors are used, a fifty per cent speed range can be had about as economically as one of twenty-five per cent. The larger range has the advantage of allowing for greater errors in the design of the system and still being able to adjust the fan speed to operating conditions. Where this large speed range does not materially increase the installation and operating costs it can be justified.

Alternating-current motors are coming into general use for fan drives in buildings. Although a fifty per cent speed adjustment may be had with a wound-rotor motor, it cannot be obtained efficiently. At the low speeds, the motor, when driving a fan, is also unstable. These conditions have caused engineers to question the necessity of this speed range for ventilating fans. It is the opinion of some that a twenty-five or a thirty-five per cent speed adjustment is usually ample.

The efficiency of a wound-rotor motor decreases over fifty per cent for a fifty per cent speed reduction from normal. This feature alone makes the problem of fan drives worthy of careful consideration by architects and engineers. If a fifty per cent speed reduction is not necessary, good engineering and economics dictate against its use.

The Simplest Is Generally the Best

Boiler installations, in Europe and the United States, that are generating steam at pressures above a thousand pounds are inspiring a widening interest among engineers in the various types developed.

Happening along during a period when boiler plants of normal pressures were passing through a cycle of circulatory and scale troubles, the development of boiler types for the higher pressures could not avoid being influenced by current fears of the obstacles which would apparently prevent safe and continued operation.

In attempting to avoid these difficulties some designers, notably in Europe, made radical departures from conventional boiler design. Moving the evaporating process out of contact with the hot gases, evaporation by superheated steam, pumps to force positive circulation and to overcome pressure difference in mediums, were incorporated as new principles in the designs.

To many American engineers, accustomed to the essential simplicity and directness of design which characterizes the normal water-tube boiler, these added complications seemed a fertile source of operating difficulties. They felt that the desirable features of the present boiler unit justified the working out of circulating difficulties by correct design detail and of scaling and corrosion by proper chemical water control.

In the beginning some troubles were encountered in applying normal designs to these high-pressure installations. Approach was clouded and solution retarded by the fixed idea that the problems were peculiar to the high pressures at which the units were operating. Continued experimentation, however, showed that they were fundamentally the same as those encountered in boilers of moderate pressure. After that progress was more rapid.

After several years of operating experience with installations under varying conditions these usual boiler types have demonstrated their ability to operate safely and continuously under pressures from 1,400 to 1,800 pounds when water is properly controlled chemically. The desirable simplicity of these designs is retained and the original difficulties overcome by removing the obstacles rather than by building around them.

Automatic Control in Refrigerating Plants

One of the problems confronting operators of refrigerating plants is how the load can be balanced in spite of two or more evaporator pressures. While several solutions are possible, the difficulty attending hand control of expansion valves cannot be eliminated.

Refrigerating plants are too seldom fitted with automatic control devices. As a consequence the engineer wears himself out trying to adjust valves to give economical operation, or, resigning to the inevitable, is satisfied to keep the machinery going without regard to economy.

Designers of refrigerating plants should adopt the custom power plant designers have followed for several years, of permitting nothing to be manually controlled when automatic devices are available.

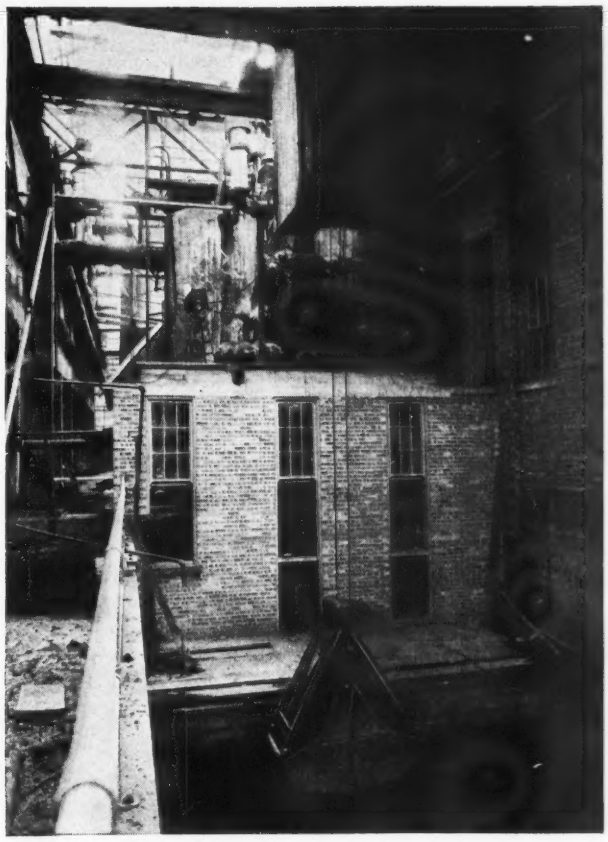
▼

POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

▼

Swift & Company Revamp Steam Supply At Chicago



Ashes are removed from outdoor sump by a grab-bucket traveling crane

Need for more capacity and dependability of supply called for replacement of a large number of worn-out boilers in three separate plants. Numerous proposals studied showed retaining of 20 existing and installation of 8 new boilers, chain-grate fired, offered greatest dollar economy

DURING the past two years the engineering department of Swift & Company, headed by Donald MacKenzie, has had the problem of determining the most advisable procedure in revamping the entire steam supply at the Chicago plant. Many of the existing boilers and auxiliary equipment had reached an age where they could not be depended upon for continuous service. Aside from this general condition, average operating efficiencies were low, maintenance on the obsolete equipment excessive, and labor cost much higher than would prevail in modern steam generation concentrated in one plant.

Figuring over a twenty-year period overhead charges including interest and depreciation and other items and operating costs such as coal, labor and power for auxiliaries, the problem was to determine how best to supplement existing equipment, or to replace it entirely by a new plant. Pulverized coal or forced-draft chain grates was an issue, and another factor entering into the decision was efficient coal and ash handling. Although generation of electrical energy had been given up some years ago and current purchased, this question was reconsidered in the light of present developments. In all, eight different proposals were considered, and the final decision was to install in one of the existing plants new boilers equipped with forced-draft chain grates, to eliminate all boilers that had reached their normal life, and to retain those boilers still offering several years of satisfactory service. The details, preceded by an outline of existing conditions, will be of interest.

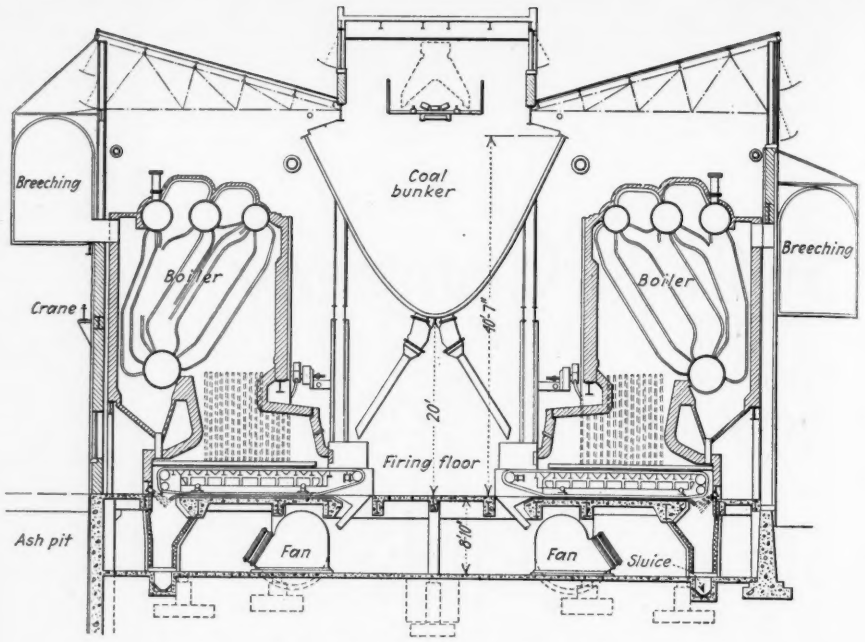
Steam was being supplied to the packing plant from three sources, designated as the east, west, and north boiler rooms, according to their location in the property. At the time the study was in process there was a total of fifty-four high-pressure boilers, with four out of use. Of these fifty horizontal water-tube boilers, thirty had reached their normal life, having seen from twenty-one to thirty years of service. They were of the old cast-iron header type, each having 4,000 sq.ft. of surface. The working pressure had been cut down to 160 lb. The other twenty boilers were more modern, having been installed in 1918. Equipped with steel headers, and containing 4,500 sq.ft. of surface, they were good for a working pressure of 200 pounds. Twelve of them had been installed in the west boiler room and eight in the east boiler room. With all of its equipment obsolete, the north boiler room was to be closed.

In each of the plants Illinois and Indiana coals were burned on natural-draft chain grates. Coal and ash were handled by pivoted-bucket carriers. Owing to the age of the equipment, and the length and weight of the conveyors, maintenance was excessive. The large number of relatively small boilers, and their separation into three plants, made the labor requirements heavy.

Records of steam consumption indicated a maximum peak demand of 750,000 lb. per hour in the heavy 7 a.m.

to 3 p.m. shift during the four winter months. The hourly mean loads ranged from 647,000 to 430,000 lb. per hour for the three daily shifts. In other seasons of the year the maximum peak approximated 600,000 lb. and the hourly mean load ranged from 300,000 lb. on the lightest shift, 11 p.m. to 7 a.m., to 500,000 lb. on the heavy shift. These figures show considerable variation between seasons, and between daily shifts as well. The maximum of 750,000 lb. was the basis of calculation.

In the the eight proposals various plans that would improve the reliability and the efficiency of steam generation were carefully weighed, taking into account the initial investment, overhead, the cost of coal, auxiliary power, repairs and labor. One plan was to equip the eight good boilers in the east boiler room to burn pulverized coal and add a forced-draft chain-grate unit to the west boiler room. As in all proposals involving remodeling, the worn-out boilers in both of these plants were to be removed and the north boiler room closed. Another proposal was to equip four boilers in the east plant to burn pulverized coal and add five new boilers with forced-draft chain grates to the west boiler room.



Cross-section of new installation shows general layout

Study was given to the possibility of supplementing the twenty good boilers in the east and west plants with a new boiler house, provided in one case with six pulverized-coal-fired boilers equipped with air preheaters, and as an alternate seven new boilers served by forced-draft chain grates. A new boiler house that would replace entirely existing facilities also was considered, the equipment to be ten pulverized-coal boilers or twelve boilers served by forced-draft chain grates.

Dollar economy pointed to the adoption of a final proposal calling for the installation in the west plant of eight new boilers with forced-draft chain grates, for which space was made available by the removal of the obsolete units. The twelve boilers in this house and the eight boilers in the last plant installed in 1918 are to be retained in a supplementary capacity for peak load and stand-by service. At present five of the new boilers are going in, but space has been made available for the other three units.

Considering all operating factors, this was the only proposal to show a profit over a twenty-year period. Compared with former operation, savings of $90,000 in coal cost, $50,000 in labor and $80,000 in repairs were indicated. A high overhead allowance cut into these savings, but a sizable profit remained. The real purpose in any of the proposals was to increase the capacity and improve the reliability of the steam supply by the replacement of worn-out boilers. The plan last mentioned best fulfilled these requirements.

Installation of the new boilers in the west boiler room was considered preferable, as its location is nearest the center of steam distribution and is adjacent to the railway tracks on which the coal is delivered. Besides, new coal and ash handling included in the estimate of this proposal made it possible to eliminate the excessive upkeep on the old equipment.

Objection to a new boiler house either to supplement or entirely replace existing equipment was made on the basis of extremely high first cost as compared to the other proposals, and in the case of the supplementary plant three boiler rooms would be operated at times. A new boiler house large enough to supply all the steam would have increased the investment several times and have meant the immediate scrapping of 20 comparatively modern boilers good for ten more years of service.

With the pulverized-coal plants equipped with preheaters, forced- and induced-draft fans, savings would not increase proportionately with the increase in gross

MAJOR EQUIPMENT OF NEW INSTALLATION

Boilers, 5, Stirling, 11,060 sq.ft.; operating pressure 250 and 175 lb. ..... Babcock & Wilcox Co.
Stokers, 5, forced-draft chain grates, 8 zones; 304 sq.ft. each ..... Illinois Stoker Co.
Drive, vertical engine and lineshaft per stoker, 4 x 5 in., 225 r.p.m. ..... B. F. Sturtevant Co.
Boiler side and front walls, sectionally supported ..... M. H. Detrick Co.
Arches, suspended type, front and rear ..... M. H. Detrick Co.
Fans, forced-draft, 5, each 50,000 c.f.m. ..... B. F. Sturtevant Co.
Drive, 35-hp. steam turbine 370 r.p.m. ..... Terry Steam Turbine Co.
Fan, overfire air, 5, each 5,000 c.f.m. ..... American Blower Co.
Drive 7½-hp. motor 1,750 r.p.m. ..... American Electric Motor Co.
Heaters, open, two, 600,000 lb. per hr. ..... Hoppes Mfg. Co.
Pumps, feed water, three, 1,500 g.p.m. ..... Worthington Pump & Mach. Corp.
Drive, 350-hp. steam turbine, 2,050 r.p.m. ..... Terry Steam Turbine Co.
Ash-sluicing system ..... Allen-Sherman-Hoff Co.
Pumps, recirculating water, 2, vertical, 1,800 g.p.m. ..... Allen-Sherman-Hoff Co.
Drive, 250-hp. steam turbine, 1,750 r.p.m. ..... Terry Steam Turbine Co.
Crane, traveling, 25 ft. span, 1 cu.yd. grab bucket ..... Link-Belt Co.
Coal handling: ..
Rotary car dumper ..... Link-Belt Co.
Fireless locomotive, steam 250 lb., cyl. 17x16 in. ..... H. K. Porter Co.
Crusher, hammer type, 200 tons per hr. ..... Pennsylvania Crusher Co.
Belt conveyor, inclined, 30 in., 250 ft. c. to c. ..... Link-Belt Co.
Belt conveyor with tripper 30 in. 240 ft. c. to c. ..... Link-Belt Co.

efficiency, because of the relatively high cost of power for operating auxiliaries. Limited experience with two trial unit mill installations in the east boiler room had pointed to a heavy power requirement for pulverizing the local coals and to considerable maintenance.

From the data available, it seemed evident that there was little difference between the net efficiencies of a forced-draft stoker installation without preheat and a high-grade pulverized-coal plant complete with air preheaters and induced-draft fans. The lower initial investment for the stoker installation, the familiarity of the operators with this type of equipment, and the relatively high cost of purchased power for auxiliary drive were the deciding factors.

Installation of a high-pressure plant was also considered, with boilers operating at 600 lb. pressure and noncondensing turbines exhausting at 100 lb. back pressure to supply all process steam. At present the exhaust from auxiliaries and the steam-driven ice machines is used for heating, hot water and the few processes where low-pressure steam is satisfactory. Live steam is supplied to a large number of operations requiring temperatures corresponding to pressures of 40 to 100 pounds. With the steam demand lightest in summer and the power load heaviest, the practice of interchanging steam and motor-driven pumps according to season had been established.

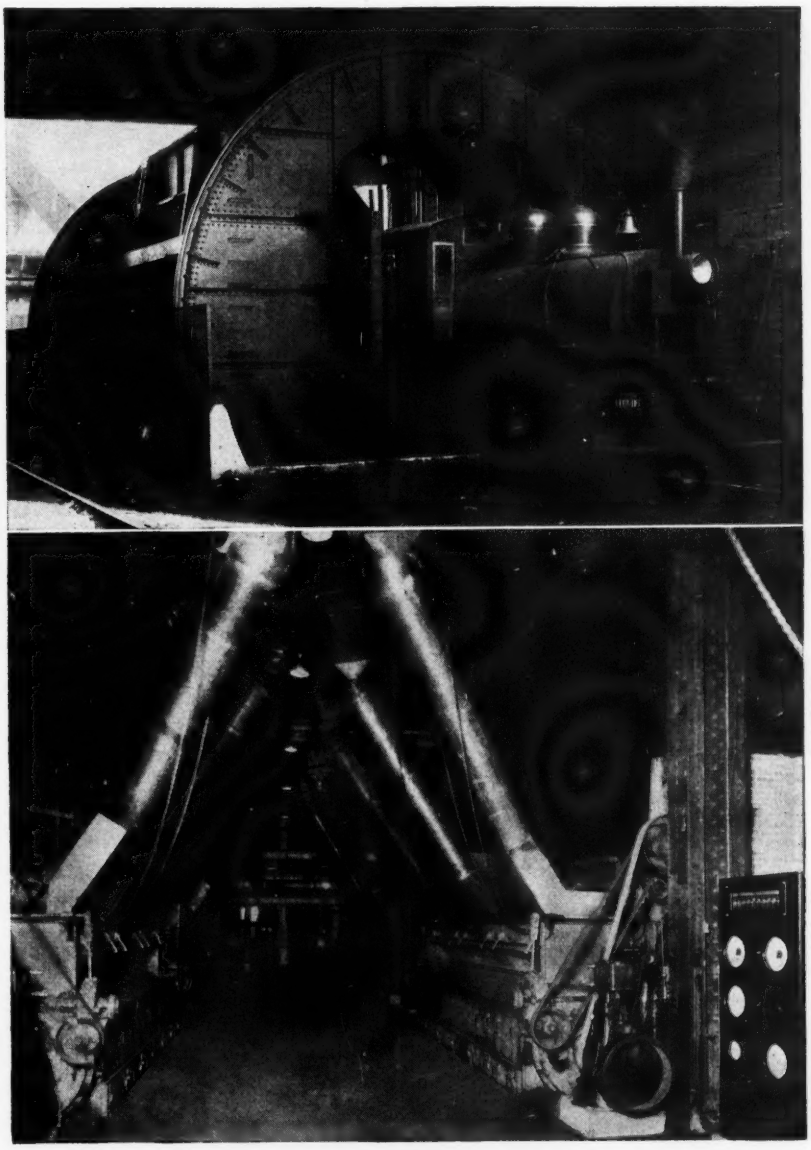
The present analysis indicated that the high-pressure plant would effect large savings in direct operating cost, but the high initial investment, several times that of the project adopted, and the difficulty of balancing the power and steam demands unless the company cared to go into the marketing of power to other consumers, reacted against this plan. Seasonal variations, with the power demand heavy in summer and lighter in winter, the steam requirements following the opposite course, and the daily divergence between these two demands, added to the difficulties of obtaining a balance. These objections and the heavy investment, plus a favorable rate for current, were the factors responsible for the decision.

Returning to the proposal finally adopted and practically complete at the present writing, five of the new boilers have been installed in the west plant and are ready for service. They are of the Stirling type, good for 300 lb. pressure, each having 11,060 sq.ft. of surface and a steaming capacity at 300 per cent rating of 100,000 lb. of steam per hour. In three of the boilers the operating pressure will be 250 lb., to supply turbine-driven auxiliaries, such as the various pumps in use, and certain deodorizing processes. The other two units will operate at 175 lb. pressure to conform with that on the older boilers. Cross-connections with reducing valves between supply headers make it possible to draw on the higher-pressure boilers for the general supply.

With the lower drum of the boiler 14 ft. above the firing floor, large furnace volume is provided. Furnace side walls are water-cooled. Fourteen $3\frac{1}{4}$-in tubes on each side terminate at the bottom in a box header serving as a clinker plate at the fire level, and at the top in a similar type of header exterior to the wall at the level of the mud drum. These headers, on each side, are connected into the boiler circulation.

Above the water-cooled area are sectionally supported front and side walls. Through these hollow walls air is drawn by a 5,000-cu.ft. motor-driven fan mounted over the front arch, and delivered with 230 deg. preheat over the fire through nozzles spaced uniformly across the front of the furnace about 4 ft. above the grate. This preheated air, mixing with the volatile as it is driven off rapidly at the front of the furnace, tends to improve combustion.

Front and rear arches are of suspended design. The former is 7 ft. long and 5 ft. 9 in. above the grate at the front, with a rise of 6 in. to the heel. To burn the carbon in the ash the 6-ft. rear arch rises to a maximum of 21 in. above the grate.



Bottom—New boilers equipped with forced-draft chain grates augment the steam supply from the boilers retained. Top—A fireless locomotive and a rotary car dumper handle plant's coal rapidly

Forced-draft chain grates of late design, including a new type of drive and an air-cooling feature at the front of the grate, serve the boilers. With 304 sq.ft. of active area divided into eight zones, these stokers are each rated to burn seven tons of coal per hour, equivalent to a rate exceeding 44 lb. per square foot of grate. Each stoker is equipped with a double drive consisting of an overhead countershaft driven by a vertical engine. Individual 50,000-c.f.m. fans driven by 35-hp. turbines supply the air for combustion.

To reduce the maintenance and labor items in the cost of handling ash, which had become excessive with the old pivoted-bucket carriers exceeding 280 ft. in length, a new hydraulic ash-sluicing system has been provided to care for all boilers in the west plant, new and old. Ash from each stoker, spray-quenched on the way down, drops into a hopper with a double-inclined bottom having a refractory-lined target across the center. Oscillating nozzles on each side wash the ashes into an open sluiceway, to be carried by propelling jets, installed every 30 ft., to an open concrete pit outside the building. Measuring 22x30 ft. in plan and 22 ft. deep, this pit is arranged to separate the water from the ash so that the former may be recirculated to the propelling jets by duplicate 1,800-g.p.m. vertical pumps driven by 250-hp. turbines. From the pit the ash is transferred directly to railway cars by an overhead traveling crane equipped with a grab bucket.

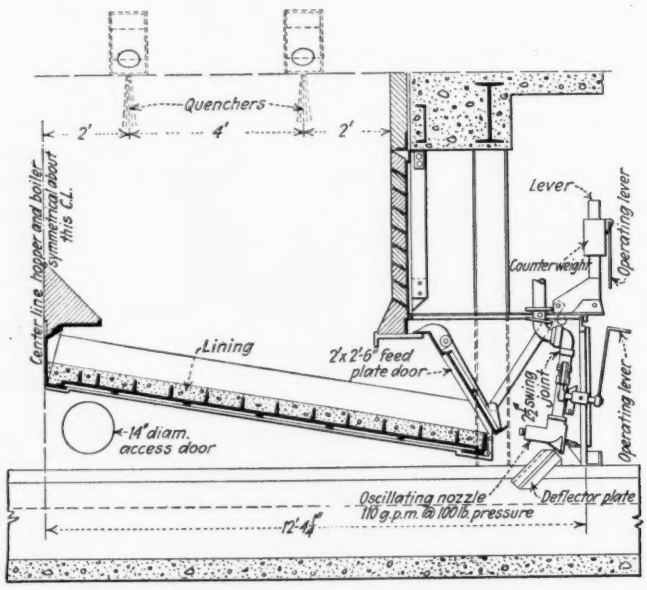
For an industrial plant the coal handling is unusual, involving as it does the use of a rotary car dumper and a fireless locomotive to switch the cars. Here again reduction of maintenance and labor, and the desire to dispose quickly of coal cars, owing to limited trackage, were the deciding factors. Fifteen 50-ton cars per day is the anticipated coal requirement for the present at the west plant. Later, when the additional boilers have been installed, twenty cars of coal per day will be needed.

From the hopper of the unloader a reciprocating feeder passes the coal to a crusher in the pit, and delivery is made to a 30-in. inclined belt conveyor running to the tops of the boiler house. Here transfer is made to a longitudinal belt with tripper passing above the main storage bunker, located over the central firing aisle of the boiler room. The capacity of the system is 200 tons per hour.

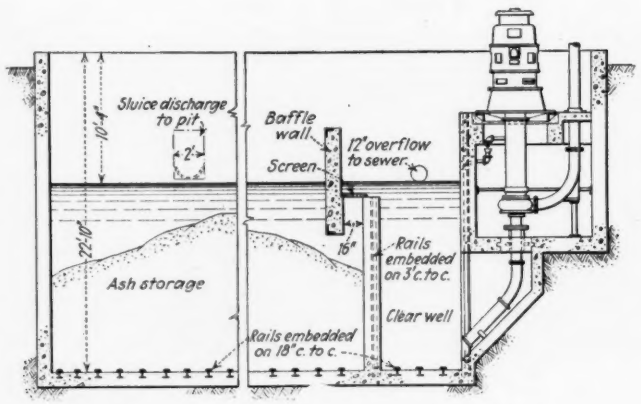
As the system capacity calls for a car of coal every fifteen minutes, it was not deemed advisable to depend upon outside switching. Gasoline and fireless locomotives were considered, with the preference turning to the latter type. With the steam available this steam accumulator on wheels was believed to be more economical and less maintenance was anticipated. It seemed well worth an investment of $7,500. With its charge of water, the locomotive weighs 45,000 lb. The tank has a capacity of 265 cu.ft., and the cylinder dimensions are 17 x 16 inches.

For the past few weeks the locomotive has been in operation. In the morning it is charged with 250-lb. steam. A normal day's service reduces the pressure to 100 lb. and the engine is still able to function, as it will operate on a pressure as low as 20 lb. and with the pressure at 50 lb. will pull one car. A small charge is put in to carry the locomotive overnight, and in the morning it is fully charged before starting the daily routine.

With much of the steam going to process, only 20 per cent of the condensation is returnable to the boiler room. As the 80 per cent make-up is city water containing seven to eight grains per gallon of incrusting solids, a soda-ash treating plant adjacent to the boiler house is in process of installation. The returns will come back to a retention tank with capacity to hold one hour's supply. Here sufficient make-up is added to meet the demand, the water treated and eventually pumped to two 600,000-lb.-per-hour open heaters in the boiler room located 22 ft. above the boiler feed pumps. Three turbine-driven boiler-feed pumps are available, each having a capacity of 1,500 gal. per minute, which is sufficient, except for extreme peaks, to carry the load.



Oscillating nozzles wash ash into sluiceway from boiler ash pit



Pumps recirculate water from clearwell of ash-storage sump

Broadcasting With Oil Engine Power

By P. J. STIEGER

THE St. Paul, Minn., station KSTP, of the National Battery Broadcasting Company, is the first radio station in the United States using a diesel engine for its operation. Of course, one of the most important items in any broadcasting system is to have reliable, continuous service in its electrical power. Inasmuch as the station operates on an average of nineteen hours per day, economy is a large item.

During the process of the construction of the plant, investigations were carefully made both as to purchasing power and generating it by means of a diesel engine. It was estimated that the average load would be 85 kw. over a period of 19 hr. a day, making the yearly consumption 589,475 kilowatt-hours.

On the basis of the 85-kw. demand and 589,475 kw.-hr. a year, the purchased-power cost would have been $8,665, or an average of 1.47c. per kilowatt-hour. It was found that a generating unit would have the following yearly operating costs:

Fuel oil	$2,947
Lubricating oil	364
Maintenance	210
Miscellaneous supplies and chemicals	150
Insurance	228
Taxes	228
Total operating cost, excluding fixed charges	$4,127

A 210-hp., three-cylinder 14x17-in. diesel engine operating at 300 r.p.m. and direct connected to a 167-kva. 3-phase, 60-cycle, 480-volt engine-type alternator with exciter, switchboard, cooling tower and other apparatus was installed. This unit is of sufficient size to allow for an ultimate station capacity of 18,000 watts, at which time it is estimated that the total load will be approximately 110 to 120 kw. The total cost of the complete power plant, including building and foundations, was approximately $24,000, including interest during construction. The saving due to the operation of this diesel generating unit is expected to be sufficient to retire the entire investment in approximately six years.

In laying out the engine room the designers realized that certain difficulties must be considered in the installation of a diesel generating unit when operating in conjunction with a radio station. The foundation must be insulated against any possible vibration being transmitted to the transmitter room, as the tubes in the transmitter are very sensitive. The foundations at KSTP are insulated from the ground with 12 in. of fine sand completely surrounding the foundations.

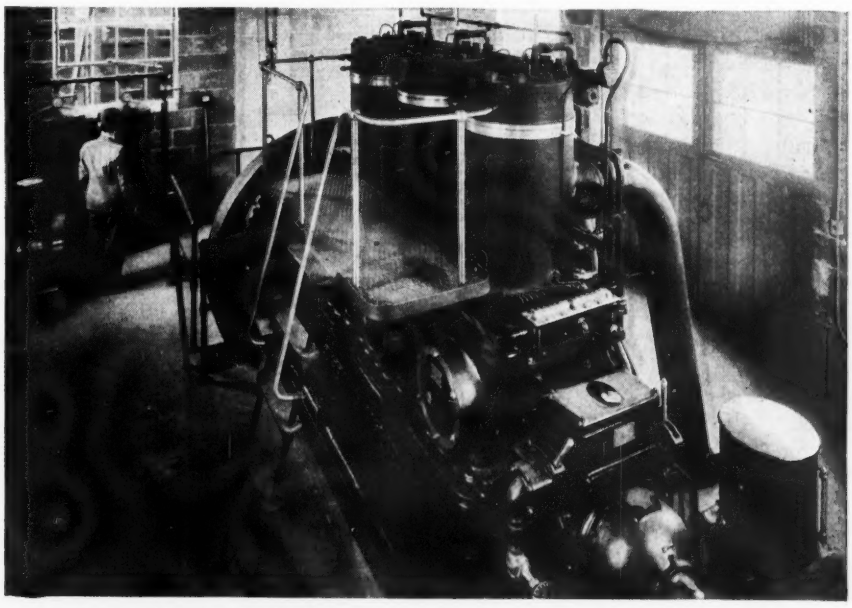
Due to the tremendous static electricity in the air, the engine unit as well as the alternator and all auxiliary equipment was heavily grounded.

The exhaust stack could not extend above the roof of the building, and in addition excellent silencing was necessary so that exhaust noise would not create any air vibration. This was readily accomplished by means of a concrete silencing pit and a silencer.

A water softener is used to soften the cooling water lost by evaporation. The cooling tower has eight spray-nozzles and receives its water at approximately 8 to 10 lb. pressure. A bypass arrangement is made in this cooling tower so that during the winter months the water can be bypassed directly back to the basin without using the spray nozzles. A centrifugal pump driven by a 3-hp. motor forces the water from the concrete cooling tower basin through the engine and spray nozzles. This pump unit is so wired that when the diesel unit is started up in the morning it obtains its energy from alternator fields at 440 volts and gets up to speed practically as quickly as does the generating unit.

Air for scavenging and cylinder charging is cleaned by filters located in a small house immediately outside the engine room. The air-starting apparatus consists of two tanks with an electric-driven compressor for the supply of air.

No operator is required for the diesel unit. The radio operator makes a tour of inspection once every two or three hours to see that the engine has ample fuel and lubricating oil. An automatic water indicator is arranged so that when the temperature of the water exceeds 150 deg. F. an alarm sounds in the radio station, where the electrical instruments are located.



The Fairbanks-Morse diesel in the power plant at KSTB

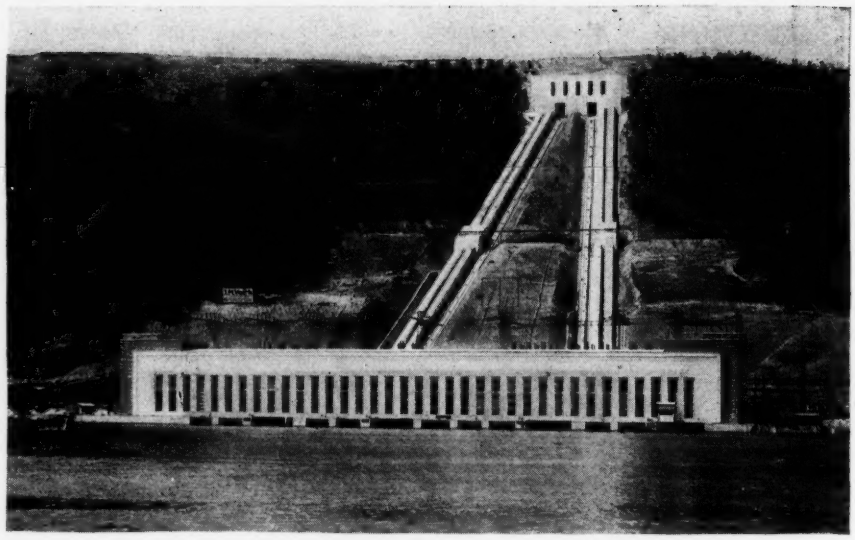


Fig. 1—Herdecke plant has been built to supply peak-load service

HERDECKE: The Largest

Four 48,000-hp., horizontal-shaft turbines operate at 506- to 534-ft. head. Three of the units consist of a turbine, generator and pump, the fourth unit has no pump. The pumps are the largest ever constructed.

HERDECKE pumped-storage power plant, on the Ruhr River, has been built for the Rehinisch Westfälisches Electricitätswerk to supply the peak loads of its power system and to improve the load factor of the steam power plants. This plant will also serve as emergency reserve if one of the run-of-river hydro plants fails, as it can be put into service very quickly. Like many pumped-storage hydro-electric plants, Herdecke operates without natural water flow. At night, when cheap power is available, water is pumped from a lower into an upper reservoir by electrically driven pumps. The electric machines are used as pump motors or water wheel-driven generators as required.

With a maximum input of about 80,000 kw. when all three pumps are in use and a maximum output of about 140,000 kw. with the four turbines in operation, Herdecke is the largest pumped-storage power plant in operation. It is of interest that this station is automatically controlled, even to the change from pump to turbine operation.

Local conditions were favorable for the plant's construction. A dam on the Ruhr River forms the lower reservoir and serves a run-of-river hydro plant. The upper reservoir, which is artificial, is near the Ruhr River and has 56,000,000 cu.ft. capacity. Fig. 1 shows the general arrangement of the project. Two steel-lined pressure tunnels lead from the upper basin to the valve house, where they divide through Y-pieces into four penstocks. In the valve house each penstock is equipped with two butterfly valves. The four penstocks then lead down the slope to the power house on Lake Hengstey and are anchored at three points. Near the four machine units are penstock shut-off valves.

The structural features of the Herdecke plant are rather exceptional. The construction of the upper reservoir made it necessary to remove 1,700,000 cu.yd. of rock and earth. The gravity dam, which acts as a retaining wall for the water, is of concrete and the side is backed by removed rock. Space for the power house was limited, therefore its ground plan was made as narrow as possible (393x65.5 ft.), nevertheless its foundation extends into the reservoir. More than 430,000 cu.yd. of concrete were used for the project.

Three of the machines are of the four-bearing type, each consisting of a spiral-casing turbine, a two-stage pump and an alternating-current machine which can be used either as a motor or a generator. The alternating-current machines and the pumps are connected by hydraulic-mechanical clutches allowing the pumps to be put in and taken out of service while the electrical machines are running at full speed. The pump is not yet installed on the fourth unit.

The draft tubes of the turbines are equipped with shut-off valves. In addition, the turbine discharges and the pump intakes can be closed with stoplogs. Racks are placed in front of the pump intakes.

Rated at 45,000 to 48,000-hp., the turbines are of the single-runner, horizontal-shaft type, built by J. M. Voith, Germany. They take 920 to 940 sec.-ft. under a head of 506 to 534 ft. Special bronze is used in the manufacture of the runners, and they are overhung on one end of the shafts. The turbine bearing is a combined thrust and steady type, with the thrust rings arranged with movable segments.

To empty the turbines while pumping, the valves in the draft tubes are closed and the water is let out by hydraulically governed casing valves while the air enters through a valve on top of the casing. When the turbines are put into service their casings are evacuated through their valves. The shafts are sealed against the entry of air into the spiral casing by labyrinth seal rings.

The pumps are of Voith-Sulzer construction. Because of their great size, considerable preliminary research and model testing were necessary. On account of the high head, two-stage pumps were considered the most satisfactory. To obtain reasonable dimensions at turbine speed the pumps were constructed as double units, Fig. 3. Each half of a pump consists of an intake and two stages. The runner has a single double-

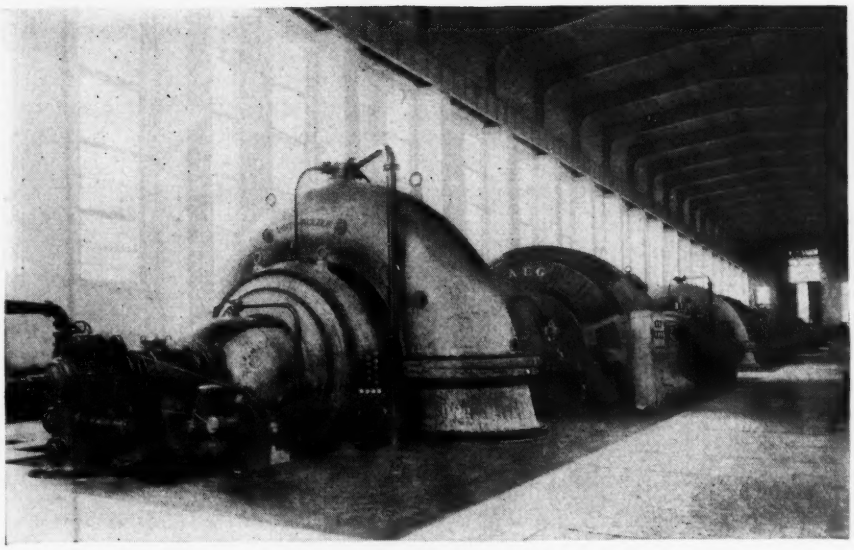


Fig. 2—The electric machines are rated at 40,000 kva. and serve as a generator and as a motor

Pumped-Storage Hydro-Electric Plant

By WALTER NETOLICZKA
Engineer
Danzig, Langfuhr

suction, high-pressure impeller mounted centrally on the shaft and flanked on each side with a low-pressure, single-suction impeller. Water leaving the double-suction, high-pressure stages is discharged into a spiral casing. The total head is about equally distributed on the two stages. According to the contract, the output amounts to 520 sec.-ft. under a head of 480 ft. and 440 sec.-ft. under a head of 545 ft., with a power demand of 36,100 and 33,650 hp., respectively.

During test, under a head of 490 ft. and a discharge of 530 sec.-ft. the power input to one of the pumps was 35,100 hp., giving an efficiency of 84.8 per cent. Under a head of 540 ft. and a discharge of 460 sec.-ft. the power input was 33,200 hp. and the efficiency of 86.3 per cent.

The spiral casings and guide vanes of the pumps are cast steel and the impellers are of special bronze with steel clearance rings. The oil-lubricated bearings support the shaft of each pump, the one on the generator end being a combined thrust and steady bearing, the same as for the turbine. Before starting, the pumps are primed by ejectors. These pumps have guide vanes similar to those of the turbines, which are operated by a special pump governor, and like those of the turbines are equipped with safety breaking bolts.

To avoid running the pumps while the turbines are operating they are connected to the generators by hydraulic-mechanical couplings, Fig. 4, that permit them to be started and stopped while the electrical machines are running at full speed. This requires a clutch of very large power and necessitated developing a new design known as the Voith-Föettinger type. It is a combination of a hydraulic-slip, hydraulic-friction clutch and a flexible coupling. The hydraulic-slip part is used for acceleration only. When the pump is running at about 95 per cent of its normal speed the friction clutch is put into service and the pump is brought to normal speed. For small changes in speed friction clutces work satisfactorily, even for transmission of large power.

The hydraulic part of the clutch consists of a primary bucket wheel *P*, Fig. 4, mounted on the generator shaft

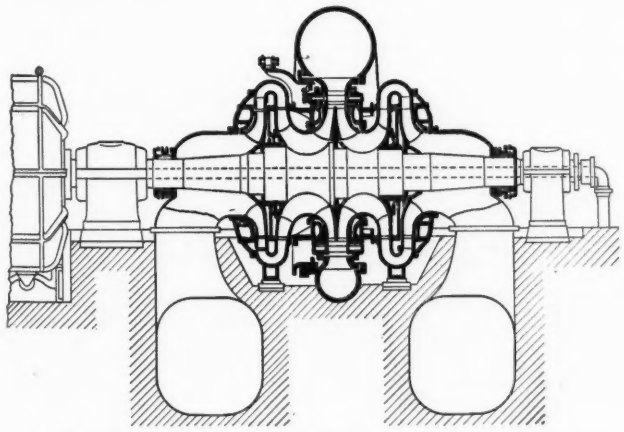


Fig. 3—The pumps are constructed as double units

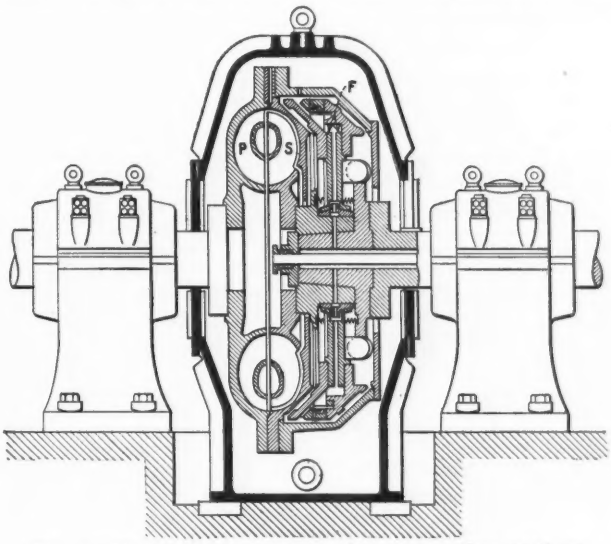


Fig. 4—Hydraulic-mechanical type of coupling used on the pumps

and a secondary bucket wheel S on the pump shaft. When starting, water is admitted between the two wheels, the primary wheel acting as a pump and the secondary wheel as a turbine. As the amount of water between the two wheels is increased a greater torque is transmitted to the pump shaft, which is accelerated

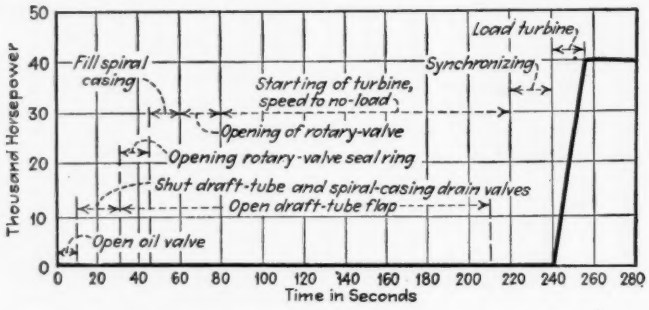


Fig. 5—Sequence of operations when starting a turbine

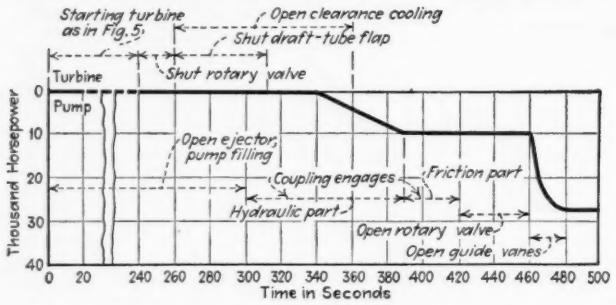


Fig. 6—Sequence of operations when starting a pump from rest

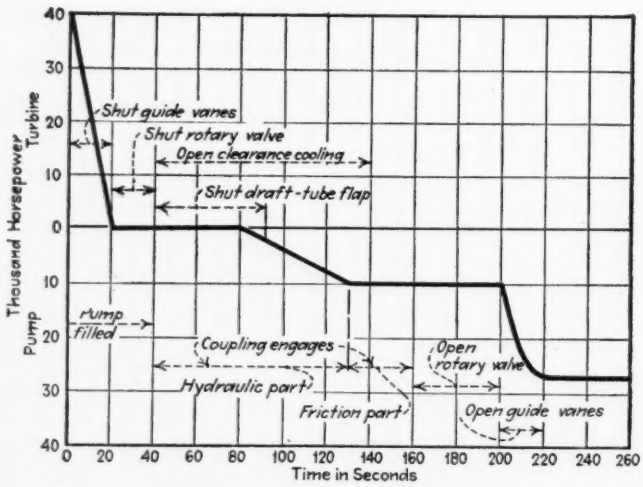


Fig. 7—Sequence of operations when changing from turbine to pump service

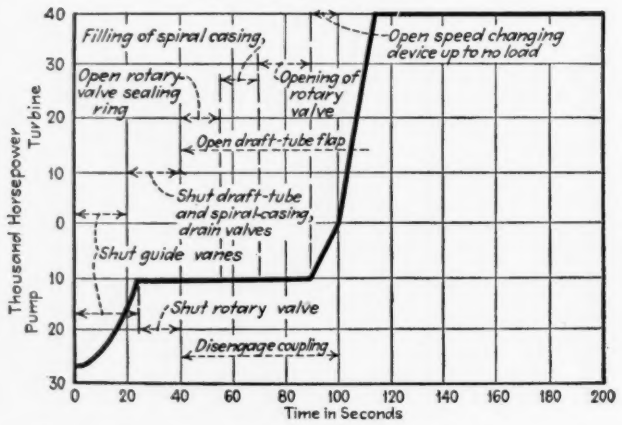


Fig. 8—Sequence of operations when changing from pump to turbine service

to about its normal speed in a short time. When this is accomplished, the mechanical part of the clutch has its water inlet opened, forcing the two cast-steel friction plates F apart by centrifugal pressure. Thus the two friction disks are pressed into contact with the friction part of the housing and the clutch is fully engaged. While the hydraulic part of the clutch has its water supply cut off after the machine is started, the friction part remains filled with water as long as the clutch is in operation. The clutch is released by closing the water inlet to the pressure chamber, which empties slowly. The drawback springs of the pressure plates lift the friction disks and the clutch is thrown out of action smoothly. The Herdecke clutches are the largest of their type, and will transmit a maximum torque of 1,500,000 pound-feet.

Two butterfly valves of 10.5 ft. in diameter are installed at the top end of each penstock. The one on the upstream side is designed for quick closing, with a counterpoise drive. The other valve is equipped for either electric motor or hand operation. The quick-closing valve can be opened only when the penstock is filled with water. For this purpose the hydraulically

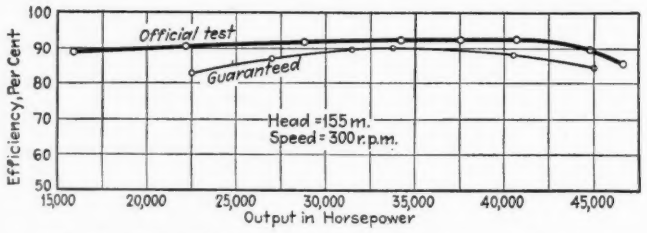


Fig. 9—Guaranteed and test efficiency curves for one turbine

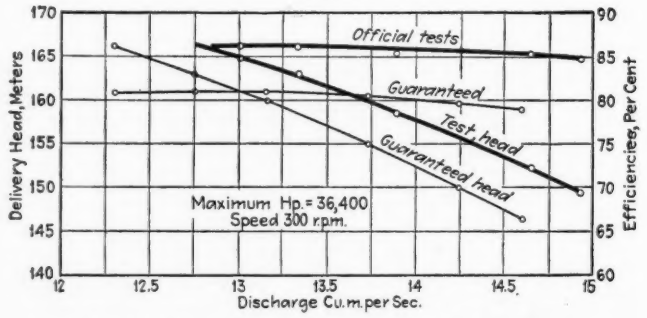


Fig. 10—Efficiency and head curves for one pump

operated gate valve in the bypass is opened and the penstock fills slowly. When the filling is completed a float device closes a contact that causes the butterfly valve to be opened by oil servo-motors which at the same time lift a weight. Should a pipe burst, the quick-closing valve is shut automatically by the weight being released. At an increasing water velocity, the shutting of the valve is caused by a paddle trip. The second valve can be opened only when the quick-closing valve is closed.

Each pipe line is equipped with air valves 3.28 ft. in diameter. The valves are governed by a float, and open only when the pipe line is empty, and close when it is filled with water. A dashpot provides for smooth closing of the valves. At the turbines and pumps in the penstocks are spherical valves. These consist of a cast-steel casing inside of which the rotating shut-off device is fitted.

Because of the automatic control of the plant and the hydro-mechanical clutches on the pumps, the equipment can be put into operation quickly. Starting from rest

a turbine can be started and put into service in 255 sec., Fig. 5. With the complete unit at rest, a pump can be put into service in 480 sec., Fig. 6. A change from turbine to pump operation can be made in 220 sec., Fig. 7, and the reverse operations can be made in 115 sec., Fig. 8. The greater part of these periods is required for the electric and hydraulic control sequence and opening and closing the main shut-off valves. Figs. 5 to 8 show the sequence of operation for putting the equipment in service under the four different conditions.

A maximum turbine efficiency of 95 per cent was attained and a maximum pump efficiency 86.3 per cent as shown in Figs. 9 and 10. The efficiency of the pipe line for turbine service is 98.6 per cent, and for pump service 99 per cent. The highest efficiency obtained for the storage operation was 68 per cent under very favorable conditions. At ordinary service an over-all efficiency of 65 per cent was reached, calculated from the output and input of kilowatt-hours of a favorable load. The losses in water friction, cooling water, air friction, seepage water in the upper basin and from other causes are considered in this computation.

▼

Cost of Operating Building Heating System

By S. M. GREEN
President Samuel M. Green Co., Inc.

IN THE Integrity Building, Philadelphia, there are 21 rentable floors above the street level, and a portion of the basement is utilized by a restaurant, with a kitchen in the sub-basement. The cubical content of the building, above the street, is 2,980,000 cu.ft., and the basement and sub-basement contain 147,000 cu.ft. The rentable area is 168,153 sq.ft., including basement and sub-basement.

As originally designed, the heating system was a straight vacuum system, with steam carried to the ceiling space above the top floor of the building and fed downward to all floors. Condensation is returned to the vacuum pump, located in the sub-basement.

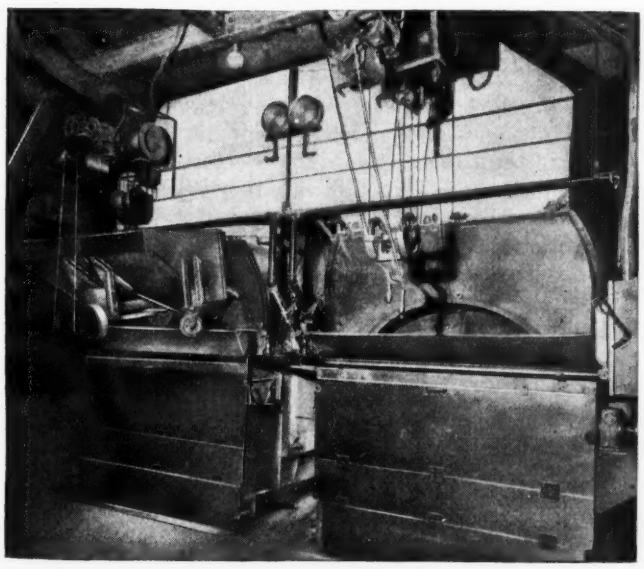


Fig. 1—Boiler room in Integrity Building, showing how coal is delivered to stoker hoppers

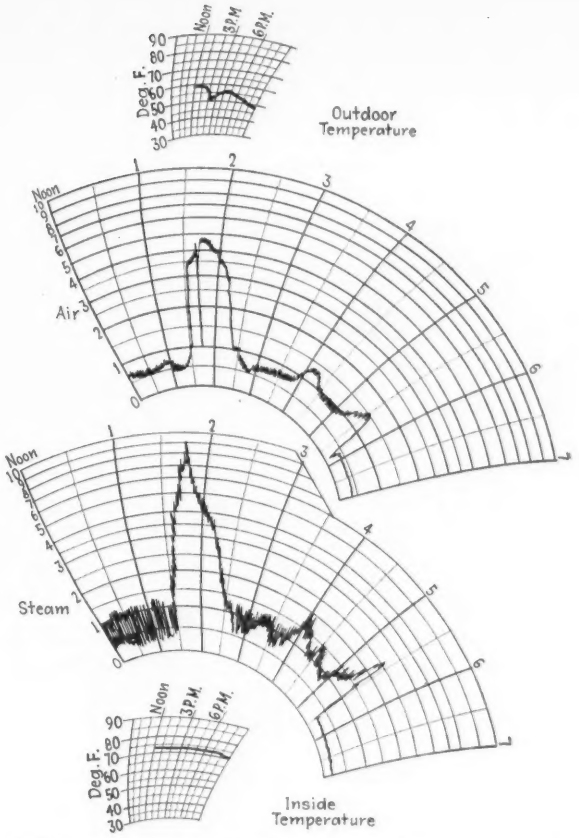


Fig. 2—Positions of charts, showing simultaneous records of outdoor temperature, air pressure, steam pressure and inside temperature

Phantom radiators are hung from perforated projecting window sills. They are inconspicuous and have proved entirely satisfactory. Owing to the design of the window sash, air leakage is practically eliminated, and the amount of radiation that would be used with ordinary sash was materially reduced, at a considerable saving. The amount of equivalent radiation installed is 27,743 square feet.

After the heating system was designed attention was called to the then comparatively new moderator system for controlling steam circulation and regulating the temperature within the building by an outdoor thermostat. This thermostat communicates with the control board through an air line. The equipment was added.

This system employs orifices at the inlet to each radiator and in the branch lines to the various portions of the system. The orifices are calculated so that the proper amount of steam is distributed to each section of the system and to permit the proper amount to flow into each radiator. With this arrangement the steam flow into the system may be controlled by regulating the difference between the initial pressure and the vacuum in the return line. This pressure difference is controlled by a roof thermostat. To compensate for weather conditions other than changes in temperature the steam flow to the system may be increased for given outside temperature conditions by a manual control.

At the top of Fig. 2 is a portion of a chart from an outdoor temperature recording thermometer. At about 1:15 p.m. the temperature started downward; about 2 p.m. it rapidly declined to 50 deg., and then rose gradually to 55 at 4 p.m. The sudden drop in temperature was due to a violent wind and heavy rain.

Below the outside temperature chart is a record of the air pressure, which is controlled by the roof thermostat.

The sudden increase in air pressure shows the response of the roof thermostat to the change in outdoor temperature, and it is interesting to note the gradual decrease in air pressure due to action of the roof thermostat as the outside temperature increased. The sudden drop of the curve before it reached its peak was due to the engineer's noticing the sudden rise, and, believing that something was wrong, operating the manual control to reduce the amount of steam flow. But he immediately noted the outdoor temperature and replaced the control to normal position, and the curve returned to its normal course under control of the thermostat.

Below the air chart is a portion of the steam chart showing how the steam pressure in the supply main responded exactly to the air pressure change, and, therefore, to the outside temperature change. The lower chart is from a recording thermometer within the building and shows no change from normal. In a test to determine operating performance a condensate meter was placed in service in February, 1930, and daily readings were taken during February, March, April and May of pounds of condensate and outdoor temperature.

From February 27 to March 3, when the outdoor temperature was from 32 to 30 deg., the steam consumption was about 0.123 lb. per square foot of radiation per hour. This gradually fell to 0.007 lb. for days when the temperature was 55 to 60 deg. Fig. 3 gives the operating data graphically from March 9 to March 21, and shows how the steam requirements run in relation to the heating requirements, as indicated by outside temperature.

Steam for the heating system is supplied by two low-pressure boilers, each containing 2,360 sq.ft. of boiler-heating surface. Each boiler is equipped with two internal hot-water heaters located below the water line for furnishing hot water to the building.

The boilers are fired by chain-grate stokers, which have an initial overfeed section and a leveling bar, and are designed for burning rice anthracite. Coal is supplied to the stoker hoppers by a truck of about 1,000 lb. capacity, which is raised to the top of the stoker by an electric hoist. When in position, a side outlet gate is opened and the coal flows in to the hopper as required.

The amount of coal used during 1930 was as follows:

	Net Tons
January	140
February	95
March	112
April	78
May	27.5
June	None
July	20
August	None
September	10
October	56
November	110
December	137.5
Total	786.0

This coal was obtained at a cost of $4.80 per ton, which brings the cost of fuel for the year to $3,772.80.

All of the coal delivered during June, July, August and September is chargeable against heating water for the building, as the main boilers do this heating. Assuming this as correct, there was used during these four months 30 tons of coal for heating water, and, therefore, during the year, at least 90 tons of coal was used for this purpose.

There were 75 loads of ashes removed, at $5.50 per load, resulting in a total cost for ash removal of $412.50. One day and one night fireman are employed at a total cost of $62.50 per week.

To arrive at approximately the cost of steam per 1,000 lb., an evaporation of 7 lb. of water per pound of coal

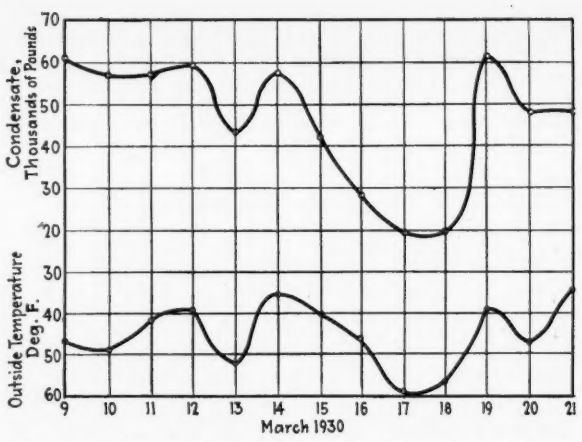


Fig. 3—Record of steam used and outdoor temperature for two weeks in March

is assumed, thus 786 tons of coal would evaporate 11,000,000 lb. of water.

The investment for boilers, stokers and sundry equipment for generating steam is $17,000, upon which the interest, taxes and depreciation, at 15 per cent, amounts to $2,500 a year. The cost of producing steam, deducting the cost of fuel for hot-water heating, is therefore as follows:

Fuel	$3,360.80
Ash removal	412.50
Labor	3,250.00
Interest, depreciation and taxes	2,550.00
Repairs	450.00
Total	$10,023.30

This is about 92 cents per 1,000 lb. of steam produced.

▼

Cooling Agitating Air

IN ICE PLANTS using high-pressure agitation it is necessary to dehumidify the air to prevent the stoppage of the air tubes with ice. Where low-pressure agitation is employed, normally, this drying is not required, due to the fact that the air tube is placed at the center of the ice can, where the temperature never goes far below 32 deg. F. until the freezing process is complete. If the original water contains a high percentage of mineral salts, however, the concentration may become so high while freezing proceeds that the freezing point is lowered well below 32 deg. Since the moisture carried by the air is pure distilled water, it naturally tends to freeze at 32 deg., and if the core water temperature falls much below this point the tubes are likely to stop up with ice.

Some plants avoid this difficulty by pulling larger cores or by coring twice. Others have resorted to the expedient of heating the agitating air. The latter practice is decidedly uneconomical, since it greatly retards freezing, besides imposing an extra refrigerating load on the plant. The increased freezing time thus occasioned will make it necessary to carry a lower tank temperature to secure the same output, in this way still further increasing the power requirements.

Other plants have solved the problem by having the blower take its suction from under the tank cover. Partial exposure to the cold brine and can surfaces has cooled this air and condensed out a great deal of its moisture content. This cooler air also retards freezing to a much less extent than would the artificially heated air mentioned.

From the viewpoint of the general public, the application of diesel engines to trucks and automobiles is of the greatest interest. The series in diesel development must necessarily include this phase even though it is of less importance to power users than the expansion in the use of large engines

•

High-Speed Diesels For Automotive Power

By OLIVER F. ALLEN
Consulting Engineer
New York City

Fig. 1 — An Oberhaensli diesel in an American truck

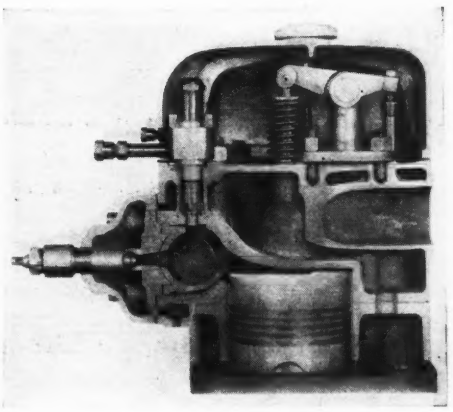


Fig. 2—A modified hot bulb is used on the Oberhaensli diesel

IT IS DIFFICULT to say when the diesel was first seriously considered as a road-vehicle engine. Probably its earliest application was for tractors. Diesel road tractors hauling trailers, but not themselves carrying any load beyond the power plant, were used more or less in Europe before 1914. Other applications may have been made experimentally, but they certainly did not assume commercial proportions. In previous articles reference has been made to the active development of the high-speed, light-weight engine following the Armistice. Attempts were made to introduce diesels for motor trucks shortly after. They were next applied to buses and in one or two instances put on pleasure cars experimentally. Benz and M.A.N. in Germany and Saurer in Switzerland were among the first to apply diesels to regular road transportation, and some of their trucks and buses have been in service for about five years.

One of the earliest applications to a pleasure vehicle was by a Russian engineer, Held, who ran a modified light-weight French runabout with one of his two-stroke-cycle engines nearly five years ago.

All of the applications made prior to about two years ago must be considered as experimental, because there was no fleet of either buses or motor trucks in regular commercial service. Well over a hundred motor trucks and a lesser number of buses had been equipped in Europe and two or three tried experimentally in this country.

That situation has changed materially in the past two years, and at the present time the diesel motor bus can be considered as a serious commercial competitor of the gasoline bus. For instance, there is a fleet of ten buses in regular service from Harrow, a suburb of London, running almost into the heart of the city. Nine are always in service and one is kept in the garage as a reserve. These buses look and act like the gasoline buses which are running on the same streets, and, in fact, they cannot be told apart except by the numbers. In taking motion pictures of them last Spring, the author had to have one of the technical staff of the London General Omnibus Company with him and carefully verify each bus to make sure that it was a diesel bus. In other words, in this particular case, so far as the riding public is concerned, there is no difference between

the gasoline and the diesel bus. Another interesting phase of this group is that the diesel motor takes the same place on the chassis as the gasoline motor which it replaces. It also uses the same transmission.

As recently as two years ago it was generally thought that the diesel motor would require stronger mountings, more space and a different transmission, and would reduce the carrying capacity or increase the chassis load when replacing the gasoline engine. That is no longer the situation. Not only in London, but in several other places, notably in Budapest, diesels are repiacing gasoline engines without change in transmission or supports, and without increasing the space taken for the engine. In the case of the Graz-Hesselmann motor built at Graz in Austria the frame and shaft with bearings are the same as for the gasoline engine and in this case there is an increase of something like 20 per cent in power instead of a decrease. Here again the same transmission is used without change.

One of the first manufacturers to develop the automotive diesel was Saurer in Switzerland. This development has resulted so successfully that over 200 of its automotive diesels are now in regular service, and the performance of one of its four-cylinder engines confirms the results obtained by the English-built engine on the streets of London.

A three-ton Saurer truck was loaded with 6,160 lb. of pig iron and after running at ordinary road speed, approaching 30 miles per hour to the outskirts of the city, climbed a mountain for over 20 minutes continuously without a stop of any kind. The grade varied from 7 to 11 per cent and averaged 8 per cent. The truck was in low gear and at no time during the entire climb was the engine running at less than 2,400 r.p.m. At the top of the hill the engine and the transmission were both in perfect condition and the truck returned to the factory promptly and without any sort of difficulty.

Saurer is now building a six-cylinder 105-hp. engine to run at 2,400 r.p.m. The London six-cylinder engines run up to 100 hp. at 2,500 r.p.m. when accelerating and sometimes up to 3,000 r.p.m. when coasting. In Berlin there are three buses that have been in regular service in a congested part of the city for from six months to a year. Their daily schedule consists of nine trips of about 12 mi. each, or a total of about 108 mi. per day, while London buses are making 150 mi. per day on a 14-mi. route.

The experience, both in Berlin and London, indicates that no more lubricating oil is required for the diesel power plants than for the corresponding gasoline plants, and that the fuel consumption is 30 per cent less with the diesels than with the gasoline buses of the same weight making the same schedules on the same routes.

The Berlin buses have M.A.N. six-cylinder 90-hp., and Daimler-Benz six-cylinder, 75-hp. and more recently Humbolt-Deutz six-cylinder, 80-hp. engines. The Berlin bus organization also has a Junkers two-cylinder, two-stroke-cycle, 50-hp. engine in a motor truck.

The Junkers engine is being applied to motor trucks quite extensively, and in actual practice it appears that the headroom required for this opposed-piston type of engine does not necessitate any radical modifications of the chassis or hood. In fact, Junkers trucks seen in Paris and London, as well as at Dessau, where the engines are made, had the same general appearance as gasoline-engine trucks.

Another constructive development is the Fiat auto-

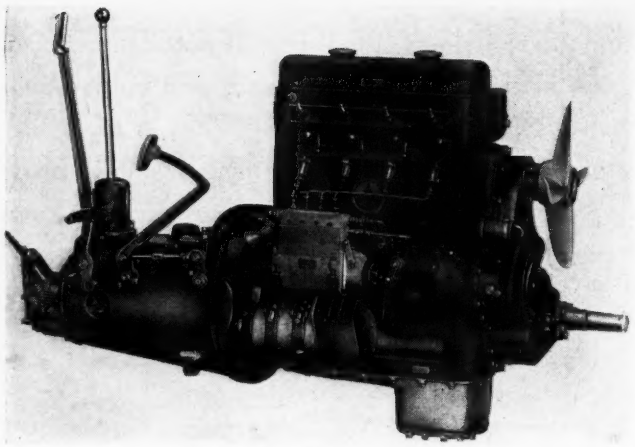


Fig. 3—The Saurer bus diesel

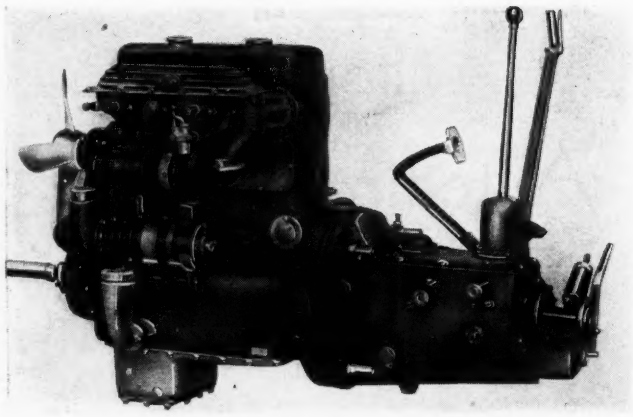


Fig. 4—A Benz light-weight engine

motive diesel, which is being built in Italy in four- and six-cylinder sizes. Ganz at Budapest is building the motors for the Budapest bus service. There are several other manufacturers building automotive diesels, among them "Vomag," using the designs of Oberhaensli of Bregenz in Austria. A cross-section of this engine appears in Fig. 2, while Fig. 6 shows the assembly.

While there is definite evidence of the arrival of the high-speed diesel of reasonable weight and size, that is, the diesel of 50 to 100 hp., in four and six cylinders running 2,500 r.p.m., and weighing (as do the various engines just mentioned) between 15 and 20 lb. per horsepower, there is not yet any conclusive evidence of the form of combustion chamber which will prevail. Among the engines mentioned there are open combustion chambers of the simplest possible design, and precombustion chambers of various types located in a variety of positions, including the modified hot bulb of Oberhaensli, Fig. 2. The Graz-Hesselmann machine includes ignition spark plugs in addition to solid-injection equipment, and some others employ electric heater plugs for starting. What these engines have in common is the use of solid injection with an injection pump for each cylinder and the general similarity of brake mean effective pressures of between 80 and 90 pounds.

None of these engines has been in use long enough or on a large enough scale to permit the accumulation of any reliable data as to their upkeep. Naturally the servicing is at first somewhat difficult because the average garage organization is not trained to handle injection-pump and other diesel problems, which are quite different from gasoline engine troubles, but in those places where servicing is being concentrated in one spot with adequate

trained personnel, as at the Peugeot-Junkers service station in Paris, the London General Omnibus Garage between Harrow and London and the Berlin Omnibus Service Garage, the servicing is going well and the feeling of the operating staffs is that, when organized with properly trained personnel, the servicing of the diesel automotive vehicle is not going to be any more difficult, and will perhaps even be simpler, than that of the gasoline vehicle. This may not be true where the spark plug is retained as an adjunct to the injection system, but should prove true where the injection system replaces both the carburetor and the ignition system.

In this country a few European engines have been tried experimentally in motor buses and on trucks. The electric-drive motor bus seems particularly fitted to the diesel motor and is being tried out with it. But the applications have not yet reached a commercial stage and in fact, so far as the diesels are concerned, do not represent the most improved types such as are now in service in Europe.

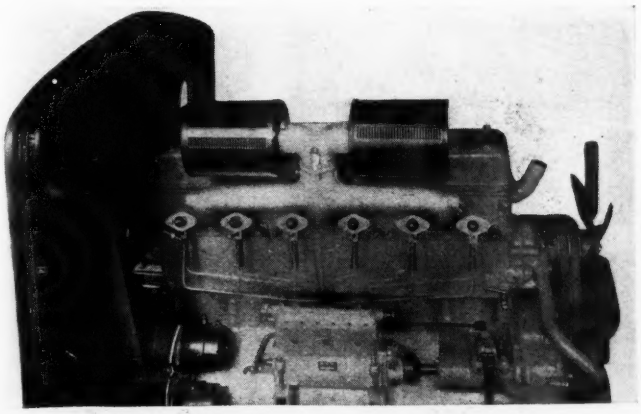


Fig. 5—Bus diesel built by Fiat

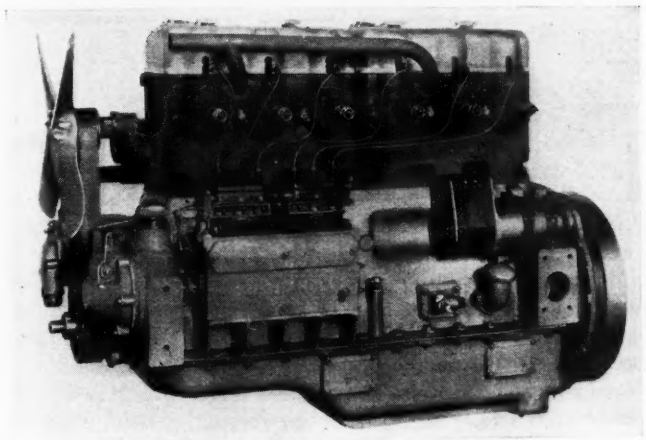


Fig. 6—Exterior of the Oberhaensli diesel

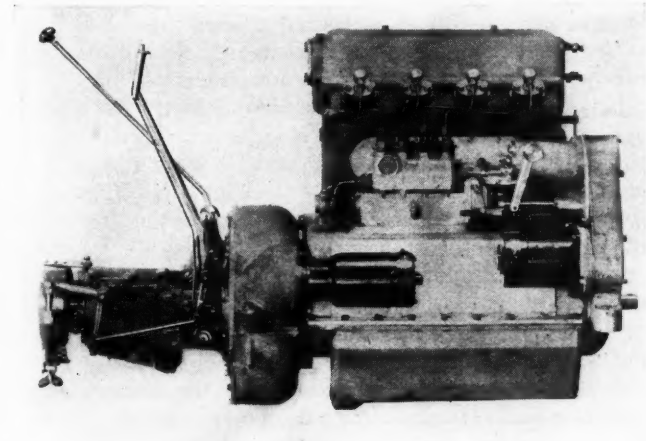


Fig. 7—The Hill diesel arranged for bus drive

While nothing serious has resulted from the passenger vehicle experiments in Europe, we have made definite progress in this country. Mr. Cummins's untiring efforts were rewarded last spring by his remarkable achievement at the Indianapolis speedway, and it is gratifying that the first time that a diesel automobile has been entered in a long, grueling competition, it was in America with an American designed and built vehicle and power plant, and that the result was outstanding, as demonstrating the reliability and fuel economy of the automotive diesel. Another example in this country which deserves mention is the pioneer work of H. Hill, of the Hill Diesel Engine Company, in motor trucks.

Summarizing the present situation, it appears that the automotive diesel for buses is an accomplished fact and that where the utility factor is high enough to make the fuel saving important, and the service is on large enough scale to justify an adequate organization for maintenance, the diesel motor bus should be applied extensively and rapidly in the United States. The 30 per cent reduction in weight of fuel, the equal freedom from nuisance of exhaust and vibration, and the somewhat greater reliability of the diesel when properly applied are all strong arguments for its adoption. At the present time its cost of manufacture is substantially more than that of a gasoline engine of the same power, but there is no reason to believe that there will continue to be any great difference in the total cost of the power plant as soon as the diesel goes on a mass-production basis. What difference there will be would seem to be adequately justified by the economies.

While standard European diesels are mostly from 50 to 75 hp., several from 90 to 125 hp. are now in production, and the 150-hp. automotive diesel can be produced as soon and as fast as the demand for it develops. The success of the Junkers indicates a trend toward two-stroke-cycle types.

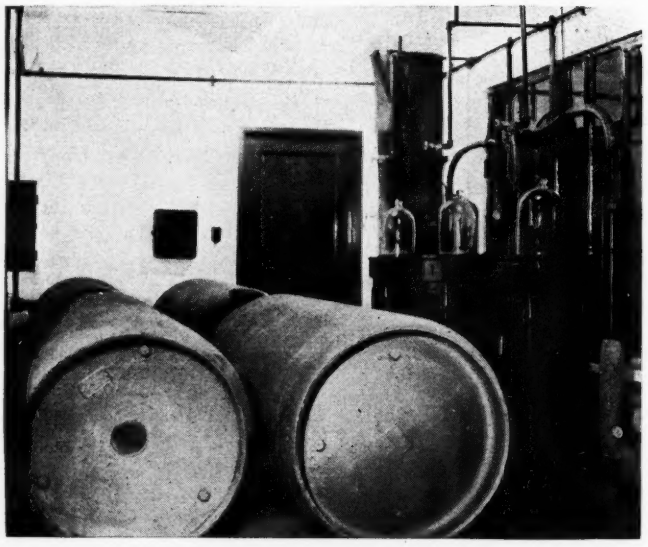
For motor trucks the development will probably be slower in the United States than in Europe, because the utility factor is lower than for buses and fuel less expensive. Also, trucks frequently require refueling at a greater number of stations and are not generally operated in fleets which lend themselves to the easiest servicing arrangements. Furthermore, many truck operators have other equipment using gasoline and do not have quite as many inducements to change over to the heavier and safer fuel as have the large bus operators. Nevertheless, with the reductions in cost and the better torque characteristics, the diesel will find itself in the truck field, just as it has in the switching-locomotive field.

For the light delivery and pleasure vehicles where the utility factor is relatively low, and in the United States the fuel cost is a small part of the total operating cost, the facility with which gasoline can be purchased on almost every street corner, plus the familiarity of operators with the present type of vehicle and the natural momentum of manufacturing to contiuue with existing types, all point to a great time lag between the adoption of the diesel on buses and trucks and on pleasure vehicles. While there are some characteristics of the diesel which indicate that it may ultimately be applied to pleasure vehicles, there is nothing to indicate its general use for this purpose in the near future.

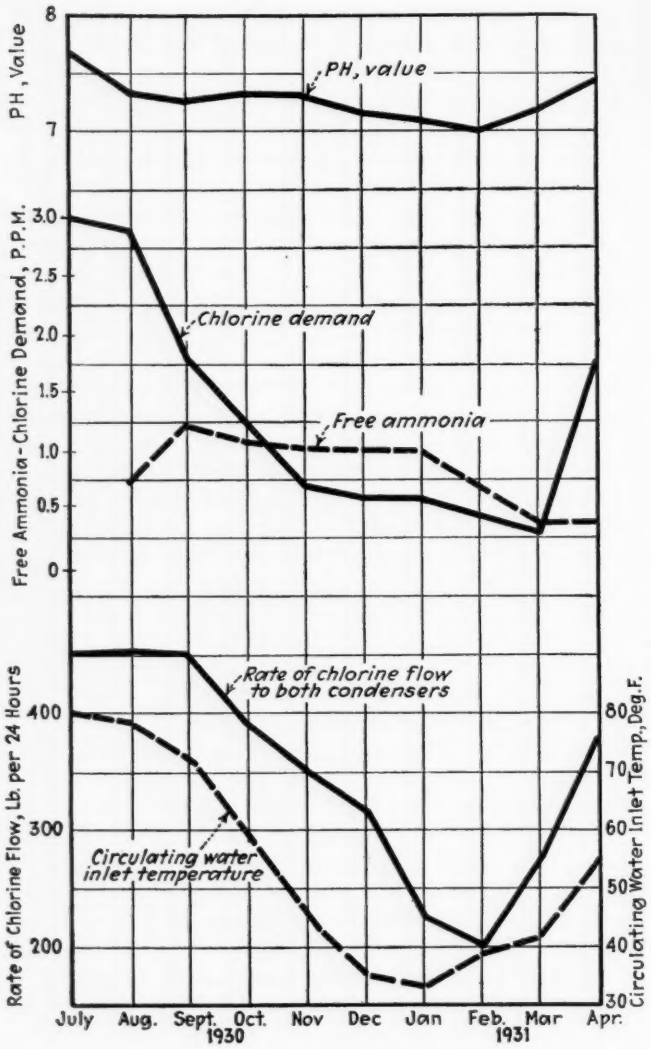
Chlorine Treatment of River Water At Powerton Station

By K. E. STOLL
Results Engineer, Super-Power Co. of Illinois

During the period of a year the chlorination of condenser cooling water has resulted in an average gain in vacuum of 0.24 in. of mercury. A gain of 0.06 in. pays for the cost of operation and maintenance of the system. No corrosive action has resulted and at no time has it been necessary to take condensers out of service for cleaning



Chlorine room at Powerton station



Characteristic circulating water data and corresponding rate of chlorine flow

LOCATED at Pekin, on the Illinois River, in the vicinity of a number of large industrial plants, Powerton station of the Super-Power Company of Illinois at present has an aggregate capacity of 215,000 kw. in three units, with an additional 105,000-kw. unit under construction. Condensing equipment consists of two 50,000-sq.ft. and one 90,000-sq.ft. single-pass reversible-flow surface condenser, with circulating pumps having a total capacity of 360,000 g.p.m. Cooling water is drawn from an intake canal to an intake crib house, where ten traveling screens equipped with washing sprays are installed. These screens are effective in removing a large portion of débris and suspended matter, but the finer suspended matter passes through the screens continuously to collect on the condenser tube sheets and in the tubes. Reversing the condenser flow three times a day is effective in keeping the tube sheets clean.

River water conditions are favorable to fungus growth and consequently condenser cleaning has been a major item. During periods of one- and two-unit operation it became necessary to introduce sand into the waterboxes of the condensers to produce a scouring action inside the tubes. During the summer months of high inlet water temperatures sanding was necessary twice a day. This daily sanding of condensers helped temporarily. Cleaning the condenser with rubber plugs during outage of a unit was a necessity.

A study of the water condition of the Illinois River from Peoria to Havana, made by the Illinois State Water Survey Division of Public Health, indicated a huge quantity of bacterial growth at the intake crib of the station.

DATA INDICATING RELATIVE POLLUTION AT DIFFERENT POINTS IN ILLINOIS RIVER

Illinois River	Total Bacteria Per C. C.	Residue on Evaporation	B Coli-Per C. C.	Bio-Chemical Oxygen Demand	Alk. Methyl Orange	Oxygen Consumed	Oxygen Saturation, Per Cent
At Lacon Channel.	1,700	367	10	7.2	136	6.4	49
At Peoria Narrows	1,000	349	5	1.6	142	5.9	61
At Pekin.....	85,000	406	10	4.2	154	5.8	52
At Powerton.....	60,000	425	100	6.1	154	6.2	52
At Powerton intake crib.....	110,000	434	100	6.4	162	7.2	63
At Havana.....	6,000	389	50	4.4	138	6.2	51

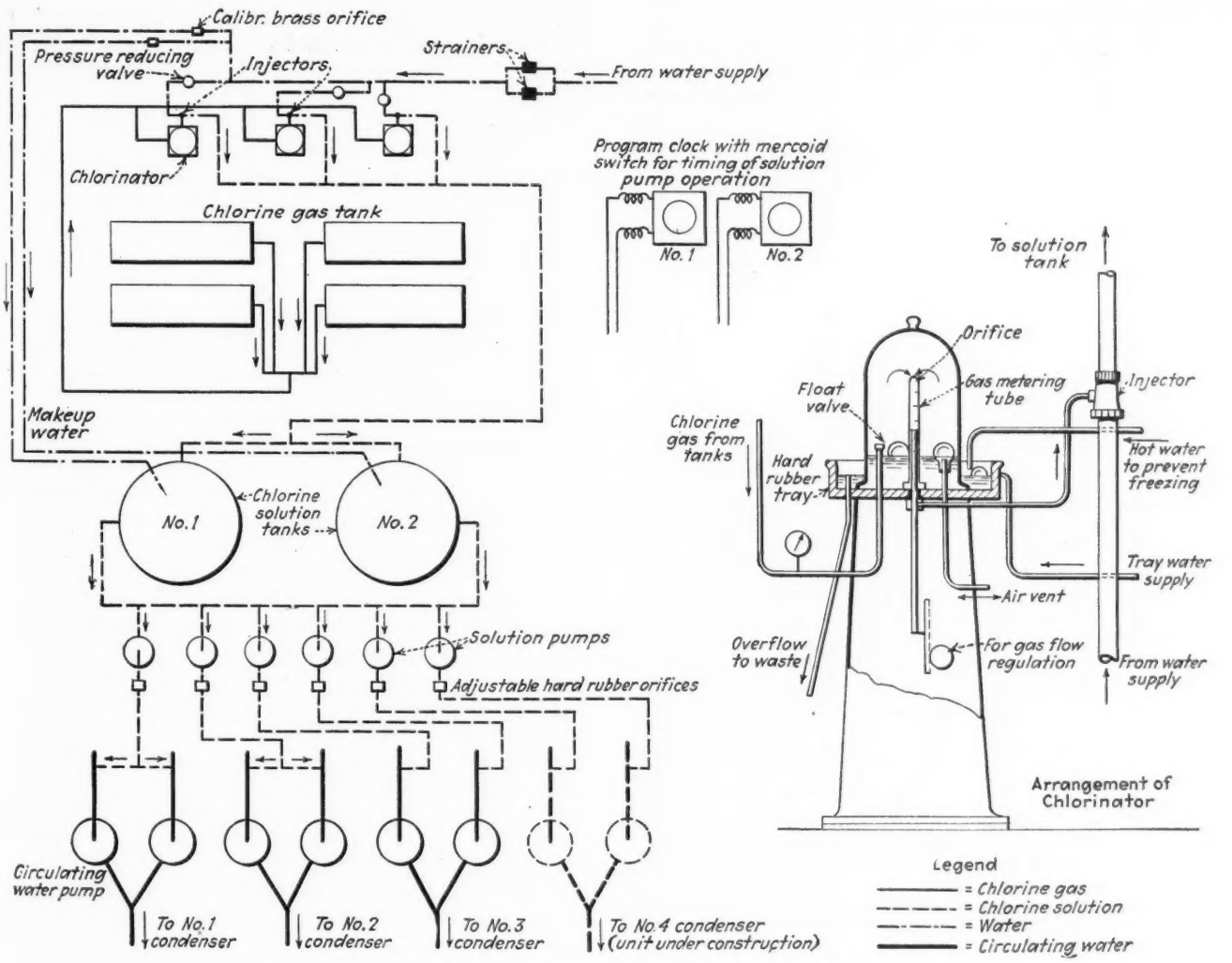
The data in the accompanying table, summarizing briefly the series of water analyses made, show the relative pollution at different points in the river. The sewage fungus *sphaerotilus* was found to predominate, with considerable other plant and animal growths. An abundance of starchy food from industrial wastes, on which the *sphaerotilus* and other bacterial organisms thrive, was found in the river. The fact that *sphaerotili* form spores guarantees their survival during the winter months when conditions are not so favorable. The most favorable temperature for this growth to multiply is 72 deg. F., so that the slimy deposit in condenser tubes increases immensely during the higher river temperatures.

Owing to the foregoing conditions it was deemed advisable to introduce a chlorine treatment for the condenser cooling water, and in May, 1930, a temporary installation of a Wallace & Tiernan chlorinator and limestone tower was placed in operation. A tank of chlorine solution was pumped intermittently to the suction side of the circulating pumps. Considerable experimental work and testing were necessary to find the most effective program on which to operate the solution pumps, the dosages necessary, and the lowest residual chlorine to carry at the condensers and yet maintain clean surfaces. Proving the effectiveness of this equipment determined the present permanent installation having sufficient capacity for four units, or a total of 540,000 g.p.m. of condenser cooling water.

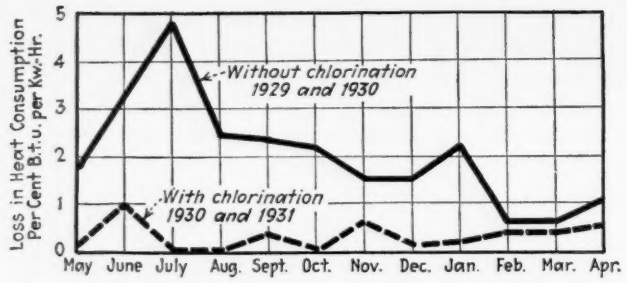
The present chlorine installation, shown in the diagrammatic layout, went into operation in February, 1931. It consists of three chlorinators, each having a capacity to feed 450 lb. of chlorine gas, when feeding continuously for 24 hours; two solution tanks 14 ft. high and 7.3 ft. in diameter having a solution capacity after being filled with limestone of 730 gal.; and six 200-g.p.m. rubber-lined solution pumps.

In operation, the water is supplied by deepwell service pumps and reduced to 40 lb. pressure through a reducing valve before going to the injector. The vacuum created by the injector draws the chlorine into the bell jar through a needle float; solution is then discharged through rubber hose to the limestone solution tanks. The limestone reacting with the chlorine to form a calcium hypochlorite solution makes it possible to carry higher chlorine concentrations and thus lessen the possibility of gas fumes escaping from the solution tanks. Limestone is added to these tanks periodically to keep them full.

The program clock trips a mercoid switch that in turn



Diagrammatic layout of permanent chlorination equipment

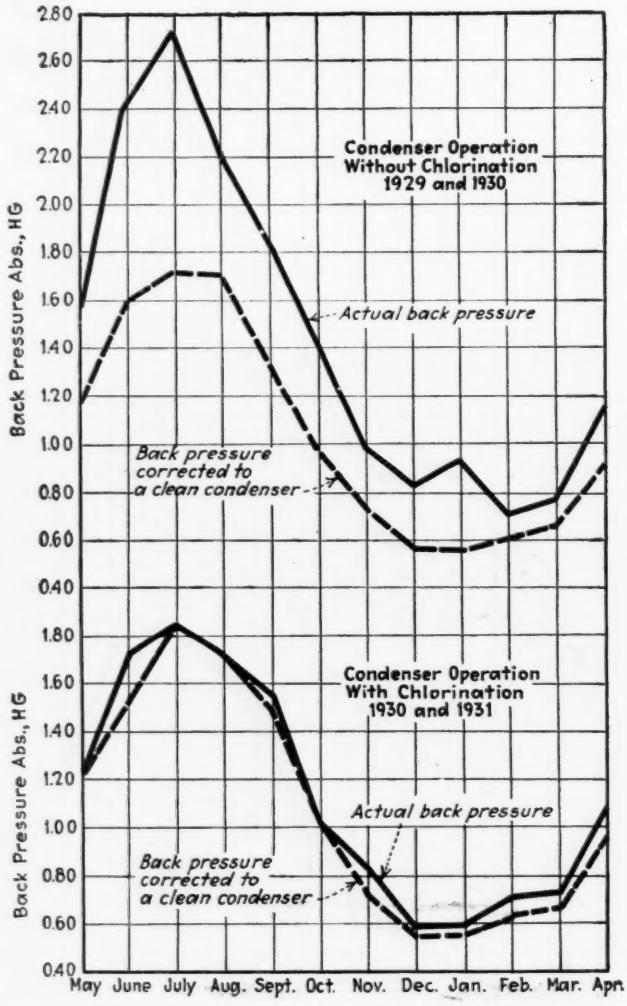


Back pressure in condenser with and without chlorination

operates a relay to close the switch on the solution pump motors. This solution is pumped through rubber-lined pipe directly to the suction side of the circulating pumps. Ton chlorine gas containers are used, and a special chain hoist and monorail are included in the equipment for handling these tanks.

The characteristic circulating-water curves show the average monthly trend of chlorine demand of river water, hydrogen ion concentration, free ammonia and river temperature. The rate of chlorine feed is a direct function of the chlorine demand and river water temperature. The program clocks are set so that the rubber-lined solution pumps operate 4 min. out of every 90.

The curves comparing condenser performance with and without chlorination for a period of a year show a decided decrease in the absolute back pressure on the condenser.



Average monthly losses in heat consumption due to dirty condenser

Particular observation of the condenser tubes has not disclosed corrosive action or any other detrimental effects. A piece of condenser tubing was weighed and placed in the condenser waterbox for over a year, with no loss in weight and no indications of corrosion. In summarizing the performance and results of chlorinating river water at Powerton the following conclusions may be drawn:

A decided gain in vacuum conditions is obtained, as indicated by the year period, with an average gain in vacuum of 0.24 in. of mercury. The greatest increase in vacuum is obtained during the summer months. Considering the cost of chlorine, limestone and maintenance of the equipment for a year, a gain in vacuum of 0.06 in. will pay for the cost of operation and maintenance. The actual gain being several times this figure makes the treatment desirable economically as well as from an operating point of view.

No detrimental effects, such as corrosion, have been encountered. The manual cleaning required has been reduced and in no case has it been necessary to take the condenser out of service to clean it. Practically the only disadvantage of the method in use is the hazard connected with chlorine gas, and much of this hazard may be eliminated by proper safety precautions.

▼

Boiler Mountings in Holland

By H. WIELAND LOS

EXISTING specifications for the construction of steam boilers in Holland were revised during 1931. Each boiler shall have two water glasses, except where the heating surface is less than 50 sq.ft. The gage cocks are entirely abandoned, chiefly because it requires more than ordinary skill to determine whether steam or water is expelled in an emergency. Furthermore, these cocks were easily clogged up by scale or other impurities.

In most cases the fusible plug has also become a thing of the past. This appliance has proved to be unreliable, but is retained for the locomotive or firebox-type boilers and some types of vertical boilers which are not suitable to the application of an alarm whistle.

It shall be possible to feed any boiler of 250 sq.ft. and upwards, from two sources.

Formerly one blowoff cock was required for each boiler, but now a set or combination is mentioned, which conforms to American practice. Four years ago I applied one of these combinations simply in order to avoid leaking. Globe valves for blowoff service are prohibited. Cocks and sluice-valves are classed alike.

It is allowed to apply Siemens-Martin steel to the manufacturing of boiler mountings, this being brought about by the advent of the high-pressure steam boiler. These mountings are entirely machined and some of them are drop-forged.

If the pressure exceeds 195 lb. water gage cocks are not fitted with a plug in order to remove scale, etc., because feed water of high-pressure boilers is considered free of impurities; moreover, it is safer.

All piping, turbine casings and auxiliary apparatus are now subjected to the supervision of the boiler inspectors.

Modern practice is creeping slowly into the doings of those connected with the steam boiler industry. Even the Scotch boiler is improved, although it is hard to convince people over here of the many advantages of the water-tube boiler.

Practical Pointers on Electric-Machine Windings

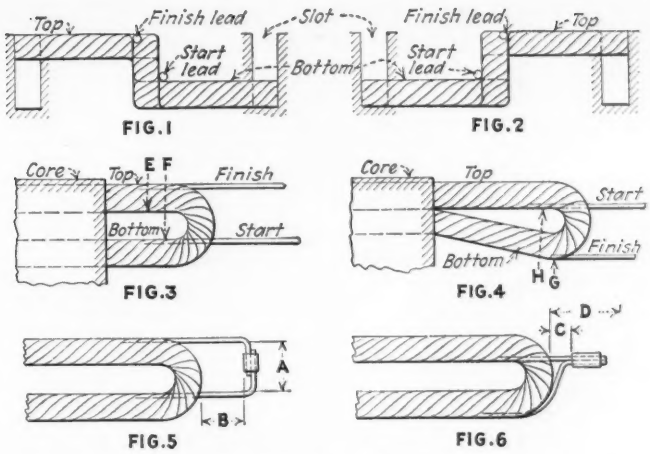
By A. C. ROE

IN THE winding of alternating- and direct-current apparatus there are a number of terms used that are important, not only to the winder, but to any one who has any contact with electrical apparatus. These terms are left-hand or right-hand coils; leads on top; leads on bottom; U-type stub connection; straight stub connection, and others, such as described in this article.

A left-hand coil may be defined as one that, when in place on the core slots and with the leads pointing toward the observer, has the top half of the coil on the observer's left, as in Figs. 1 and 7. A right-hand coil is one having its top half on the observer's right, Figs. 2 and 8.

"Leads on top" is a term used to denote the method of bringing out the leads in reference to the air gap of the machine. "Top" in all cases indicates that part of a coil nearest the air gap. Fig. 3 shows how the leads are brought out on top of one coil. In Fig. 8 the coils have their leads brought out on top. It should be noted that in designating the method of bringing out the leads "leads on top" means that the finishing lead is brought out from the top of the top half of the coil and the starting lead is brought out from the top of the bottom half of the coil.

"Leads on bottom" means that the starting lead is brought out from the bottom of the top half of the coil, and the finishing lead is brought out from the bottom of the bottom half of the coil, as in Fig. 4. The coils in Fig. 7 have their leads brought out in this way. The starting lead is the one on which the coil is started when winding it on the shuttle, and the finishing lead is the one on which the coil is completed. The starting lead is always in the center of the coil, or brought out from between its top and bottom layers.



Figs. 1 to 6—Types of coils and coil-lead arrangements used in armature windings

Fig. 1—Left-hand coil. Fig. 2—Right-hand coil. Fig. 3—Coil leads brought out on the top. Fig. 4—Coil leads brought out on the bottom. Fig. 5—U-stub connection, coil lead on top. Fig. 6—Straight stub connection, coil leads on the bottom.

"U-stub" is a term indicating the method to connect adjacent coils in series, in each pole-phase group, and is used for machines having operating voltages of 2,200 or higher. This connection is made as in Fig. 5, the distances A and B being varied to suit the voltage.

A straight stub connection is shown in Fig. 6. The leads are brought together and left projecting straight out. Distance C should not be less than $\frac{1}{4}$ in. Fig. 9 shows a wound stator with straight stubs, left-hand coils, with leads on the bottom. When distance D, Fig. 6, which is the space between the nose of the coil and the end bell or bracket, is too short, the stub connections are bent down between the coil ends, thus increasing the clearance between the ends of the stub connection and the end bell.

The foregoing terms govern factors that affect the operation of the apparatus, and they should be checked

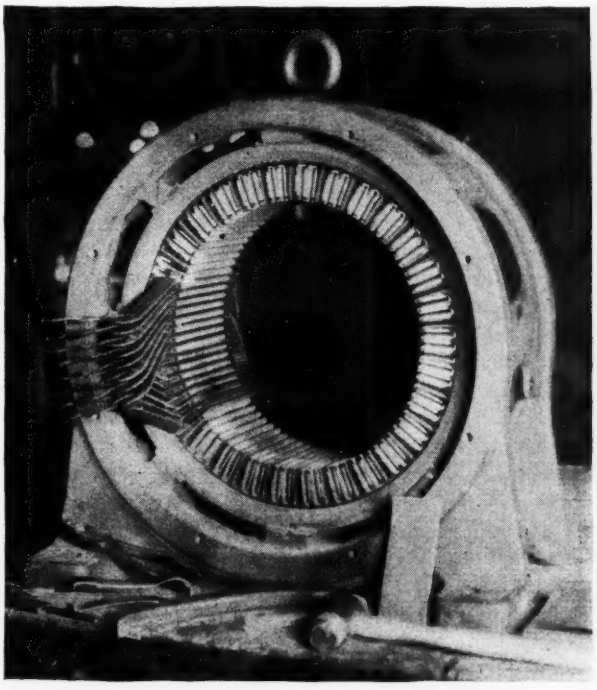


Fig. 7—A group of left-hand coils, in a stator, with the leads on the bottom

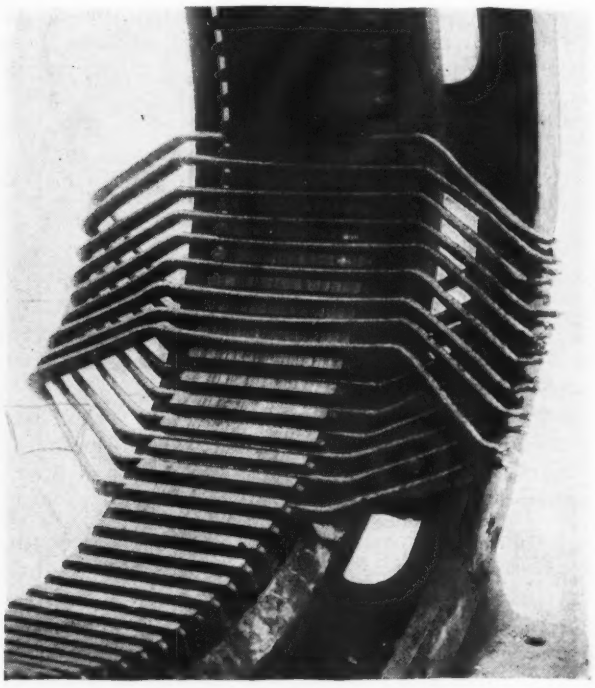


Fig. 8—A group of right-hand coils, in a stator, with the leads on top

Fig. 9—A completely wound stator with straight-stub connections, using left-hand coils with the leads on the bottom

before stripping the stator or rotor for rewinding. Changing from a left-hand to a right-hand coil will change the direction of rotation in a motor, and the lead polarity in a generator.

When coils have their leads brought off the top as in Figs. 3 and 8 there is more clearance between the starting lead and the adjacent coil in the stator windings than when the leads are brought out as in Fig. 4. For rotor windings the lead arrangement of Fig. 4 provides the greater clearance. The reason for this is that in Fig. 3 diameter *F* is larger than diameter *E*, therefore the chord between adjacent coils on diameter *F* is longer than the chord at diameter *E*, where Fig. 3 represents a stator winding. Considering Fig. 4 as rotor winding, the chord at diameter *H* is greater than that at diameter *G*. These factors are important on large units, as changing from one method to the other might prevent the new coils from going into the winding.

From the foregoing it is obvious that any spare coils kept for repairs should be checked to see that they are correct, and that a new winding should check up with the original in the several points explained.

▼

Excitation Control Systems For Synchronous Motors

By CARL C. NELSON*

SYNCHRONOUS MOTORS require direct-current excitation, and means must be provided to control the apparatus furnishing it. There are various methods of providing excitation, the most common being a direct-current bus; a direct-current, or belted exciter; and a small motor-generator set, consisting of a squirrel-cage induction-type motor driving a direct-current generator.

The first method includes larger motor-generator sets which provide direct current for a number of devices. The control for providing excitation under this class is a manual or automatic field switch, ordinarily part of the motor controller. Where the bus voltage must be maintained constant, say at 125 volts, variation in excitation must be obtained with a rheostat in series with the motor field windings.

In some cases the direct-current bus feeds the fields of a group of synchronous motors only. By adjusting the voltage for the machine requiring the highest value, say 100 volts, the motor field rheostat can be partly turned out, thereby reducing the loss over that obtained when the bus voltage is carried at 125. If the synchronous motors are alike, and the excitation is carried the same on all motors, the motor rheostats can be turned out entirely and the bus voltage adjusted to give the excitation required.

Control for providing excitation by the second system would be the same as that for the first except that the excitation would be varied by a small rheostat in the shunt field of the exciter. This rheostat varies the voltage of the exciter, and the losses in it are much less than in a rheostat used with synchronous motors obtaining excitation from a bus.

The control for providing excitation under the third class has a number of variations. In addition to manual or automatic field switch on the synchronous-motor controller there is required the control for the motor of the motor-generator set. The squirrel-cage motor may be started on either reduced or full voltage, but ordinarily the latter method is used and an across-the-line starter is employed. Across-the-line starting of motor-generator sets may be provided as follows:

1. Separate push button for magnetic starter on motor-generator set.
2. Starting from a push button which starts the synchronous motor, when an automatic starter is provided for the latter.
3. Motor of the motor-generator set is connected with fuses through the main synchronous motor switch to the line.

When direct current is required for the operation of relays, contactors, etc., on the synchronous motor controller, method No. 1 must be used in order that the motor-generator can be started, and direct current be made available for operating the synchronous-motor control.

When the synchronous-motor control is operated by alternating current the motor-generator set can be started in parallel with the synchronous motor. This is accomplished by connecting the operating coil of the control relay on the synchronous-motor starter for the squirrel-cage motor in parallel with the operating coil of the contactor on the starter. Both the synchronous motor and motor-generator set are then started from the same push button.

Method No. 3 is simple and is used especially on low-voltage installations. With high-voltage synchronous motors this method would require potential transformers between the synchronous-motor switch and the low-voltage squirrel-cage motor. Methods No. 1 and 2 are recommended in preference to No. 3.

Where motor-generator sets are used to supply the exciting current the excitation of the synchronous-motor field coils is varied by regulating the exciter voltage by a small rheostat in its shunt field.

*Control Engineer, Electric Machinery Manufacturing Company

Factors to Consider In Classification of Coal

By A. BEMENT

QUITE RECENTLY considerable attention has been given to the subject of coal classification. The movement apparently has had its source in what may be designated as academic circles. The study appears to have as an object the devising of a more comprehensive scheme for comparison of different coals on the basis of relative chemical characteristics than any scheme thus far proposed. The question, however, is not one of mere academic significance, because coal is generally used in some form of industrial service, and the various applications present problems that cannot be answered in any general scheme of classification. By way of explanation it may be well to consider how chemical characteristics influence industrial selection of coal.

Sulphur generally is considered an objectionable element in coal, and in most cases in which coal is used this is true. In the refractory industries, however, a brick-maker in producing certain kinds of face building brick desires to secure a dull finish. The presence of sulphur in the fuel used to burn the brick is effective in securing the desired appearance in the product. Especially is this true when either the coal or the clay from which the brick is made contains chlorine, which tends to produce "glaze," an effect not desired on the ware. In certain cases of this character sulphur content has been a governing factor in fuel selection. In making glazed ware the proposition is reversed, as for such ware sulphur tends to spoil the desired bright effect.

The amount of volatile content acceptable may be influenced by a variety of purposes for which the coal is used.

Nitrogen is an element present in coal in small amount, and usually receives little consideration, but as an element in the byproducts from coke manufacture it assumes importance. In a certain instance the selection of a source of coal supply was governed by higher nitrogen than in other competitive coals.

Phosphorus also is a minor element usually attracting little attention. In the case of coal for coke production for use in the blast furnace the presence of this element is objectionable and may be the governing factor in selecting the fuel.

Iron, as one of the elements in the ash associated with coal, is objectionable as it tends to clinker formation. This is a matter having significance as affecting coke manufacture for household use. On the other hand, iron in the coal used in making blast-furnace coke is not considered objectionable, as it joins with that released from the ore, increasing the yield of the furnace in proportion to the amount of iron derived from the coke.

Arsenic is an element that may be present in coal in small amount. There are, however, certain industries in which the products of combustion come in contact with the product being processed. In such cases arsenic becomes highly objectionable.

Ash associated with coal is a factor of outstanding importance as having a bearing on the value of coal in service. Quantity, character and fusing temperature all have important influences. Fusing temperature has in recent years assumed special importance. For instance, two factories in Michigan, operated by the same company, were compelled, because of government zoning restrictions during the war, to use coal from the Eastern interior field in place of coal from the former source of supply. At other factories this company used No. 2 nut coal from Illinois. Under the changed conditions the Illinois No. 2 nut was supplied to the Michigan factories, and the nut coal performed so well that the local managements desired the same size after the zoning had terminated and return had been made to Eastern sources.

A coal of this size, averaging about 3 per cent ash, less than 1 per cent moisture and high in heat value, was purchased. In service the results in the two factories were quite different. At one factory the boilers were served by semi-shaking, hand-fired grates. In the other factory the fuel-burning equipment was single-retort underfeed stokers.

Difficulty was experienced at the hand-fired plant. While the ash was small in amount, it fused at low temperature, so that the clinker melted and ran into and sealed the air openings in the grate. As a result the factory was compelled to shut down until other coal could be obtained. At the other factory the coal gave a remarkable performance. With the underfeed stokers a hard finished clinker was produced and no difficulty was experienced. The management at one factory said that the coal had no value at all, and discontinued its use. At the other factory the same coal was considered to be excellent fuel. There may be some question as to how this coal should be classified, considering its service application.

Size an Important Factor

One of the most important factors governing the value of coal as measured in economic results, is its size. The coal producers of Illinois may be credited with an important improvement in coal preparation which in large measure has been responsible for the development of its efficient utilization. Many years ago these Illinois operators adopted the practice of separating screenings into certain small prepared sizes. At the main mine tipple 2x1¼-in. size was made. This size was given the name of No. 2 nut and, being suited for domestic use in cook stoves, was also designated as stove coal. When these terms originated coal 3x2 in. was designated as No. 1, but this size no longer bears that designation. For several years it has been known as 3x2-inch.

In a rescreening plant the 1¼-in. screenings were converted into 1¼x¾-in. size, known as No. 3 nut and also as chestnut; and ¾x⅜-in. coal, called No. 4 and also pea size. The remainder of the coal that would pass through a ⅜-in. screen was called No. 5. In later years this size has been known as carbon.

Originally these small prepared coals were made as the result of a coal-washing process. However, as the expense of washing and the performance of the unwashed product became factors, washing has been given up generally, so the product now largely enters the market as mined, depending only on its size characteristic in its claim on the markets. These small prepared sizes, Nos. 2, 3 and 4, average about 2 to 3 per cent higher in heat content than the screenings. Results in service, however, are much better.

For many years an Illinois factory containing three 1,500-sq.ft. boilers, served by side-feed stokers, had used screenings as fuel, but as the business expanded difficulty in carrying the load increased. Eventually conditions reached a stage where the factory performance was interfered with, owing to low steam pressure, although all three boilers were in service. The fuel was changed

from screenings to chestnut coal, obtained from such screenings as were formerly used.

As a result the load was carried on two boilers, with the third in reserve, and a little later the capacity of the factory was increased 100 per cent, and the load still carried on two boilers. Operating experience shows that chestnut is superior to screenings for capacity of a little over 100 per cent, while the results at this Illinois factory, as obtained for several years, is an increase of 160 per cent. Such performance presents a problem to any scheme of classification.

Classification that leads to a better understanding of the complicated problems involved is one thing, and one that lends itself to the exploitation of one coal, or one coal field as against another, is another. The various coal-classifying schemes that have been devised heretofore have been used largely for the commercial exploitation of certain coal fields. One of these rated coal of a certain field as 15 times better than another competitive field, although the maximum possible B.t.u. in one case is 15,000, and the minimum in the other is 10,000, a difference of more nearly 50 per cent instead of 1,500 per cent.

▼

NCT3—A Recent Addition To the Heat-Resisting Alloys

By JOHN L. EVERHART

CHROME-NICKEL-IRON alloys, several of which have been developed by German organizations, notably Krupp, are being used to a considerable extent for elevated-temperature service. A recent addition to this group is an alloy known as NCT3. This material contains larger proportions of chromium and nickel than the well-known 18-8 and is to a greater extent identified with the heat-resisting alloys produced in this country. The analysis limits are shown in Table I. A study of the analysis shows it to be similar to several of the most popular analyses developed in this country, although the chromium-nickel ratio is somewhat different.

NCT3 is obtainable in both cast and wrought forms with the same analysis, and therefore may have wide application in the field requiring metals for elevated-temperature service. It cannot be hardened by heat-treatment. However, mechanical working causes a stiffening of the material with a rise in tensile strength and a decrease in ductility, the effect varying with the degree of working. The alloy is restored to its softest and most ductile form by heating it to a high temperature and either quenching in water or cooling rapidly in air.

Physical Properties

Typical physical properties which may be expected in wrought material as determined on 1-in. round-rolled bars are shown in Table II. Values are given for both hot-finished and water-quenched material. "Yield Point" is a misnomer, as there is no drop of the beam with this material like that obtained with low-carbon steels. The value given in the table was determined by the use of dividers. Physical test values on hot finished specimens may vary widely as they are dependent on the degree of working of the material, and the figures given

TABLE I—ANALYSIS

	Per Cent (Max.)
Carbon	0.20
Manganese	0.70
Sulphur	0.03
Phosphorous	0.03
Silicon	2.00
Chromium	23.0–27.0
Nickel	17.0–21.0

are merely indicative of the changes produced by working. It loses ductility, as measured by the elongation and reduction of area, with increasing temperatures. The minimum values are obtained at a temperature of about 1,500 deg. F.

Resistance to Scaling

An indication of the value of a material for service at elevated temperatures may be obtained from scaling tests, as resistance to oxidation is necessary if a material is to be suitable for such service. Samples of NCT3, and low-carbon steel, 1 in. long by about 1 in. diamter, machined to obtain surfaces which were free from scale and comparable in finish, were exposed to a tem-

TABLE II—PHYSICAL PROPERTIES

	Hot-Finished	Water-Quenched
Rockwell hardness	B–95	B–85
Yield point, lb. per sq.in.	55,000	35,000
Tensile strength, lb. per sq.in.	95,000	85,000
Elongation, per cent (2 in.)	35	55
Reduction of area, per cent	55	70

perature of about 1,500 deg. F. in the firebox of an industrial furnace in which fuel oil and gas were used as fuel. The samples were placed so that they were employed by the hot flue gas but were not exposed to the flame. In a period of six months the NCT3 sample was very lightly scaled, and the carbon-steel sample was practically destroyed.

NCT3 is being produced in this country by several alloy steel manufacturers. It is obtainable not only in the form of the usual castings for furnace parts but also in a number of wrought shapes. The latter include seamless tubing, although the tubes are produced by a special process and not by the ordinary tube-rolling methods.

▼

Coefficients of Diesel Spray Nozzles

INVESTIGATION at Langley Field has shown that for the small sizes of nozzles employed for high-speed compression-ignition engines a smooth entrance passage to the throat of the orifice is necessary for a high-efficiency of flow.

A beveled leading edge to the orifice gives higher coefficients than a rounded leading edge. The coefficient of discharge, which ranges from 0.2 to 0.8, depends upon the geometrical shape of the nozzle and not upon the size of the orifice. For the nozzles having the leading edge of the orifice beveled and all corners in the flow passage slightly rounded, the coefficients were identical, regardless of the effective head or the back pressure that was employed. For the nozzles having the leading edge beveled and corners in the flow passage sharp, or the leading edge only rounded, the coefficients were different for the conditions with and without back pressure when the same effective head was used.

PRACTICAL AIDS TO OPERATION

Power Factor of Single-Phase Load On a Three-Phase Circuit

IT IS SOMETIMES of value to be able to obtain the power factor of a single-phase load connected to a three-phase circuit from the readings of two single-phase wattmeters or watt-hour meters in a manner similar to

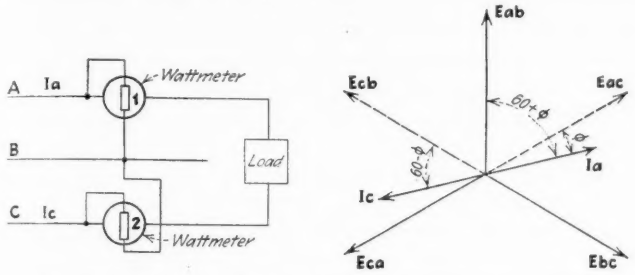


Fig. 1 (Left)—Single-phase load on a three-phase circuit
Fig. 2 (Right)—Vector diagram of the voltage and current Fig. 1

that in which the power factor of a three-phase load is obtained. The power factor of a single-phase load can be obtained in this way if the load is connected to the two lines in which the current coils of the wattmeters or watt-hour meters are connected as shown in Fig. 1.

A curve, Fig. 3, similar to the ordinary curve for a three-phase load can be drawn from which the power factor may be obtained, when the ratio of the smaller reading to the larger reading of the wattmeters is known.

Fig. 2 is a vector diagram showing the relations of the currents and voltages in the two meters. E_{ab}, E_{bc}, and E_{ca} are the three three-phase line-to-line voltages. The single-phase load current I_a is, at unity power factor, in phase with the voltage E_{ac} and hence 180 deg. out of phase with E_{ca}. If the power factor of the load

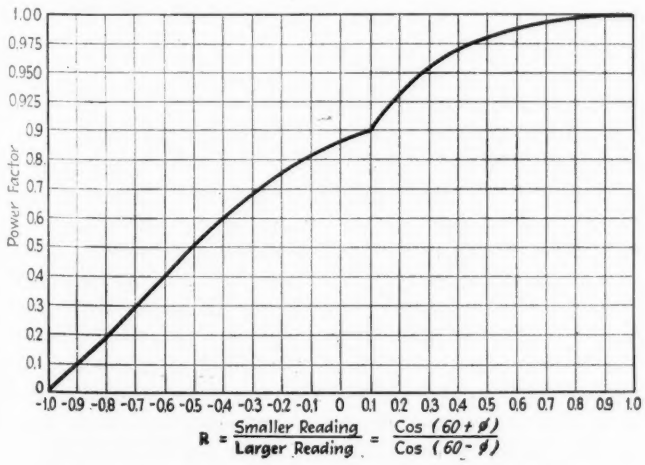


Fig. 3—Power-factor curve for single-phase load on three-phase circuit

is lagging, then the load current I_a will lag behind the line voltage E_{ac} by the angle ϕ. The readings of the two meters will then be $E_{ab}I_a$ Cos $(60 + \phi)$ and $E_{cb}I_c$ Cos $(60 - \phi)$ and the ratio of the smaller reading to the larger reading will be $\left(\frac{\text{Cos } (60 + \phi)}{\text{Cos } (60 - \phi)}\right) = R$.

The relation between the power factor and the ratio R is

$$\text{Power factor} = \sqrt{\frac{3}{\left(\frac{R-1}{R+1}\right)^2 + 3.}}$$

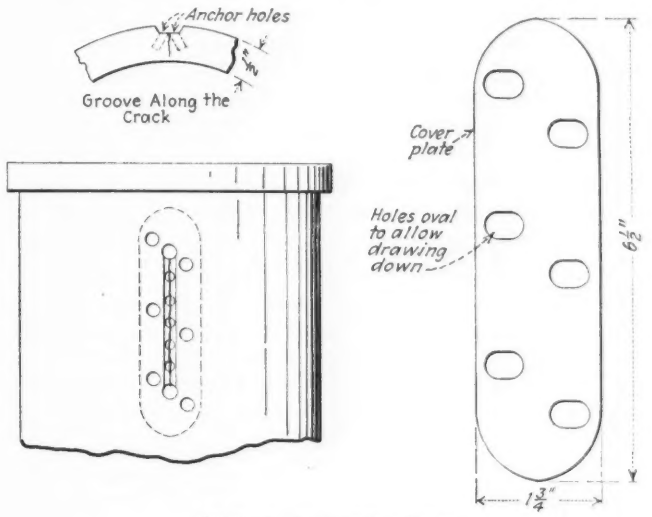
This formula is obtained by a mathematical process that is too involved to be included in this short article.

Montreal, Que. M. S. MACGILLIVRAY.

Repair of Diesel Engine Cylinder Liner

A CYLINDER LINER in one of our engines was found to have a crack about 5 in. long extending straight down the liner from a point just under the upper flange. It was decided to make an attempt to repair it with iron cement.

A $\frac{3}{8}$-in. hole was drilled at each end of the crack as deep as possible without penetrating through the liner. With a round-nose chisel a channel about $\frac{5}{16}$ in. wide and of equal depth was cut to join the $\frac{3}{8}$-in. holes. At intervals along this channel $\frac{5}{16}$-in. holes were drilled at an



Method of repairing liner

angle to provide anchorage for the cement. A coverplate $6\frac{1}{2}$ in. long and about $1\frac{3}{4}$ in. wide was dished along its length, shaped carefully to the liner and drilled for $\frac{5}{16}$-in. cap screws. The holes were filed oval to allow for drawing down the coverplate without crowding the cap screws. Holes were then drilled and tapped in the liner to correspond with the holes in the coverplate, which was tested for fit and alignment.

The coverplate and channel in the liner were filled with Smooth-On No. 1 well tamped in. The coverplate was then put in place, and the cap screws tightened with a small, light wrench, until all were snugly seated. Care had to be exercised to get full threads in the tapped holes, and to have the cap screws fill the holes snugly when the plate was drawn down to place.

Abras Grandes, Prov. de Camagüey, Cuba. THOMAS C. HULTON.

CURRENT COMMENT

Why, When and How to Make Load Tests on Motors

REGARDING C.O.H.'s question in Dec. 15, 1931, number of *Power,* concerning load tests on motors, I have in mind a plant which consists of foundry and machine shop. This plant has in operation several hundred horsepower of motors, both alternating- and direct-current types being used. There are cranes and stationary motors. A weekly inspection is made of all motors actively in use, but motors that are not used are covered with heavy paper and tied. If repairs are required these are completed in idle periods. Crane motors and others which are actively engaged practicaly all work days, and some 24 hr. a day, are repaired and inspected on Sundays.

Every six months load tests are taken on all stationary motors. As the class of work being done on the machines, the size of drills and other tools, the depth of cut and the speed determine the load, varying readings are the usual thing. The readings are considered satisfactory if the overload is not over 20 per cent for comparatively short periods of time. Where group drives are used the horsepower is seldom sufficient to drive all machines for steady operation. The class of machines on the group drives allows some to stand idle while others are being used. This is the best feature of a group drive. The friction load is noted during test, and also the load with the particular class of work being done.

If proper meters are used and the tests are made with reasonable accuracy, and a record compiled of the existing conditions, it will be possible to make considerable savings in power and to improve operation. Each motor and its starting equipment should be numbered and the machine it drives identified. This information, along with the nameplate data on the motor, should be put on a card with spaces for friction load, maximum load and power factor. Such a record will prove beneficial in many ways.

There are few plants in which improvements cannot be made by careful tests of motors to eliminate causes of abnormal current. Often a motor will be found to pull large friction loads. The friction load may often be reduced by rearrangement of belting, checking the machine bearings, realigning the equipment. Of course it is impossible to get all equipment in the plant operating perfectly, but the larger leaks should be stopped. Often in a change of manufactured product conditions arise that require changes of motors. Proper test data will show how these may be made most economically.

The question does not state the current used or the operating voltages, but I assume that the plant operates on alternating current, the voltage on the cranes, if any, being 220; the smaller stationary motors the same and the larger ones 2,200 volts. This layout could be served with the following meters:

1 voltmeter, scale range 0 to 150 and 0 to 600.
1 polyphase wattmeter with 2.5- to 5-amp. current windings and 110- and 220-volt potential windings.
2 ammeters, scale 0 to 5.
2 current transformers for 10 to 800 amp.
2 current transformers for 2,400 amp., for testing plant load. These transformers are optional.
2 potential transformers, ratio 2,200 to 110 volts.
1 megohmmeter with 500-volt generator.

If desirable to check lighting circuits a single-phase wattmeter will be necessary. If the system is 230-volt direct-current the following instruments will be sufficient for ordinary tests:

1 voltmeter, scale range 0 to 15, 150 and 300.
1 millivoltmeter with shunts for 20, 200, 500 and 750 amp.
1 special shunt for total plant load, 2,000 amp. (optional).

In general it is best to purchase meters with a scale so that the full-load current of motors will be about two-thirds scale reading. This will give one-third scale for measurement of overloads. When the benefits which are sure to follow the use of testing instruments are apparent it will be easier to get an appropriation for additional equipment. GRADY H. EMERSON.

Tarrant, Ala.

CHECKING MOTORS is important for efficient application and operation, as without such tests there is no way to tell which motor is correctly or wrongly applied to the load it drives. To determine the requirements of a drive and check up existing installations is next to impossible without suitable metering equipment. For such a purpose a portable graphic wattmeter should be used—then there is a permanent record for future reference. When a change is contemplated for a particular drive reference can be made to the chart of the motor in question, which will help to determine the most efficient change as to speed, production, change of material and cost of power.

The graphic meter should be portable and provided with the necessary shunts and instrument transformers for the range of loads to be tested. Where only one set of current transformers is contemplated, the solid type is preferred. The split-core type can be put on a conductor quickly, but its use is limited. The graphic wattmeter should have at least two chart speeds, that can be switched from one speed to the other quickly, as conditions may require. When starting a motor the maximum load might be of such a short duration that only a straight line would be made on the slow speed on the graph. By switching the meter to high speed before starting a better record will be had of the motor load. After the motor has accelerated its load the speed of the graph is switched over to normal rate of travel to record the load of the machine.

The starting, as well as the running, characteristics must be known properly to determine the size and type of motor. To drive machines having a large flywheel effect requires a motor having different starting and running characteristics from those having low inertia, such as a centrifugal pump. An example will show the value of load tests. A press driven by a 15-hp. motor caused a lot of trouble with broken gears. In this case the testing equipment was paid for in two years by correcting the trouble, from the savings in reduced maintenance and repairs and increased production.

The press was driven direct from the motor pinion to the flywheel. The teeth on the motor pinion would break after about a month's service, making it necessary to

replace the pinion at a cost of $11. The graphic meter was purchased and showed that a heavy starting current was taken for about 45 sec. to bring the flywheel up to speed. The temperature rise on this motor was high, although the meter indicated only 3-hp. input when the flywheel was up to speed and the press running idle. The meter showed 30 hp. on the down stroke of the press, and back to 3 hp. after a few seconds and before the next stroke, with a frequency of operation of about 40 strokes per minute.

An analysis of the starting curve indicated that the motor did not have sufficient starting torque to bring the flywheel up to speed in a reasonable time without overheating, the motor being a standard squirrel-cage using a reduced voltage starting. The 30-hp. input on the down stroke of the press was caused by the motor's taking practically the whole load of the down stroke, it being a constant speed type that did not allow the flywheel to slow down and give off some of its stored energy. This also caused the teeth to break on the motor pinion, due to the sudden shock when load was applied to the press. It was decided to put in a 5-hp. across-the-line motor, of the high-starting torque and high-slip type. Installing this motor cured the trouble.

Milwaukee, Wis. J. F. WISINSKI.

Sodium Sulphide or Ferrous Hydroxide

REFERRING to the question which appeared in the Dec. 8, 1931, number of *Power*, with regard to the use of sodium sulphide and ferrous hydroxide for removing oxygen from water after the water leaves the heater, I wish to point out that it is probable that the engineer who asked this question meant sodium sulphite instead of sodium sulphide.

Sodium sulphite is a soluble salt and removes the oxygen by combining with it to form sodium sulphate, which also is soluble in water. Ferrous hydroxide is oxydized to ferric hydroxide by oxygen and forms an insoluble floc in the water.

In the 1930 feed-water treatment report of the Prime Movers Committee of the N. E. L. A. there was a statement by the Milwaukee Electric Railway & Light Company, describing its engineers' experience with ferrous hydroxide. They prepared their own ferrous hydroxide from copperas (ferrous sulphate) and caustic soda by dissolving them in condensate in a closed vessel and allowing them to react to form ferrous hydroxide. The condensate was decanted after the ferrous hydroxide had settled, and then the ferrous hydroxide was washed and again decanted to remove the sodium sulphate formed by the reaction of the copperas and caustic soda.

Ferrous sulphate, which is more readily obtainable than ferrous hydroxide, reacts in a similar manner, forming ferric sulphate, and then, if the pH value is sufficiently high, reacts with hydroxides to form ferric hydroxide, which, as stated, is an insoluble precipitate.

Since the original question limits the use of these two agents to feeding them after the water leaves the heater, it can be seen that it is more desirable to feed sodium sulphite, which does not form an insoluble product, than it is to feed ferrous sulphate, which forms an insoluble product. The reason for this is that most authorities believe that the presence of insoluble solids in the boiler salines increases the foaming tendency. Therefore, it is more desirable to use a substance which remains in solution in preference to one which forms an insoluble product, when no means are provided subsequently to remove the precipitate.

The amount of sodium sulphite required for each cubic centimeter per liter of oxygen present is 5.5 p.p.m. The amount of ferrous sulphate $FeSO_4 \cdot 7H_2O$ required for an equivalent amount of oxygen is 50 p.p.m. On the other hand, sodium sulphite costs 6c per pound, whereas ferrous sulphate costs only about 0.7c per pound.

Therefore, for equivalent amounts of oxygen the cost of treatment by either method is approximately the same.

The increase in total solids due to the addition of sufficient sodium sulphite to react with a cubic centimeter per liter of oxygen is 5.5 p.p.m., while the increase in total solids for an equivalent amount of ferrous sulphate is 17.5 p.p.m. The amount of oxygen remaining after the feed water leaves the open heater is generally less than 0.5 cubic centimeter per liter. Therefore the increase in total solids will be one-half this for each reagent.

From the above it can be seen that these two reagents have two entirely different fields of application. The sodium sulphite is useful where the open heater is not used in connection with a feed-water treating system. The ferrous sulphate is useful where it is fed after the open heater, which is a part of a hot process feed-water treating system.

As to the relative efficiency of these two reagents, it has been found that both work equally well; fine results have been obtained by the use of either.

Another similar reagent which has been used in the past is acid sodium sulphate, $NaHSO_3$, although with this latter agent it is necessary to construct the feeding equipment of acid-resistant material and to take precautions against overfeeding where the natural alkalinity of the water is low. This salt reduces the alkalinity of the water as well as removes the oxygen, and sometimes is fed to correct the sulphate carbonate ratio as well as remove oxygen.

T. P. BROWNE,
New York City.

Red and White Leads for Pipe Joints

THE QUESTION and answers in the Jan. 5, 1932, number of *Power* dealing with white and red lead as pipe-joining compounds suggest the following:

Our hot-water system deteriorated to such an extent that we decided to repipe it; naturally we used brass piping. After the job was started I noticed that our master mechanic was using red lead. I questioned this and advised him to plug the end and try out the line. He was amazed to discover that 85 per cent of the joints were leaking, which was due to the fact that he could not seat the joints as far as they should have been, owing to increased friction.

I then advised him to take the line down and wash the threads off with gasoline and coat them with a solution of powdered graphite mixed with machine oil, the same compound that V. C. Wood, Deer River Powder Company, Copenhagen, N. Y., quoted in *Power*, with the result that every joint could be seated, for this compound eliminated the friction.

Notwithstanding the fact that the threads were not touched other than to be washed, when the second line was tested out it was found to be 100 per cent tight.

Drummonsville, Que. NORMAN G. GLATTFELTER.

READERS' PROBLEMS

EXCESSIVE CONCENTRATION IN JACKET WATER—*We have a plant with three diesel engines and for cooling use an atmospheric cooling tower with pumps and gravity-feed tank, the so-called open cooling system. A water softener is used for make-up water. Naturally the concentration rises, in time, so high as to make complete change of the circulating water necessary. Could I not recirculate the cooling water proper through the softener to hold the concentration low and eventually maintain zero-test water in the system? Our engines have collected quite a bit of scale from raw water.* M.O.B.

If you circulated all of the jacket cooling water through the treatment equipment, the latter would have to be very large, and ultimately the concentration would increase to as high a value as when only the make-up is treated.

To hold the concentration to a fixed value a small amount of the jacket water should be drawn off at the same time the make-up is added. The amount drawn should be such that the concentration is held at the desired volume.

BURNING CRANKCASE OIL—*I should like some information on a problem which has come up in our plant. We have a great deal of automobile crankcase oil that has increased to such an amount as to become a nuisance. I suggested we burn it under our boilers, but I am at a loss as to how to handle it in conjunction with our stokers. We should like to place the burners in the peepholes in the firedoors because our boilers are set side by side, with no room between them, and the stoker is in the way in the front.*

The holes in the doors are 3½ in. in diameter. We have no compressed air in the plant and must use steam to atomize the oil.

I should appreciate any suggestions or information as to how or where we could make or buy a burner that would be satisfactory. Of course, I do not expect to carry the load on oil. A.R.W.

It is possible to insert the nozzle through a 3½-in. hole in the firedoor. There is no reason why you should use air for atomization—or steam for that matter even if it is available—since most of the manufacturers of oil burners are prepared to supply mechanical atomizers. In this type the pump pressure is run up to about 180 lb., and the nozzle is so designed that the oil sprays out in the finely atomized condition. There is one danger, however, in burning crankcase oil under boilers, and that is, the oil may be highly saturated with gasoline, which, under favorable circumstances, might explode if ignition did not occur promptly upon introduction to the furnace. On the other hand, much of this oil is so burned with entire success.

If the amount of crankcase oil available is sufficient to justify the cost of the equipment, you should reclaim this oil rather than burn it under boilers. It has been found that crankcase oil, when properly reclaimed, recovers its former lubricating values. The equipment would consist of a heater to heat the oil to a point where the gasoline vapor would be driven off, and then a chemical tank into which the oil is run and mixed with a caustic; the caustic then forms a sludge with the carbon particles in the oil, and the oil after settling, is drawn off. It may then be passed through a centrifuge. At present several oil filter manufacturers build reclaimers.

▼ ▼ ▼

Burning Boiler Oil in Diesels

Summary of Readers' Opinions on the Previous Question

IN A DIESEL PLANT of 2,250 kw. with an annual capacity factor of 71 per cent would there be an actual saving if boiler oil costing 3.25c. a gallon was used in place of 30 Baumé oil costing 5.2c.? Would this change entail the use of a light oil when an engine is started? To what viscosity should the oil be heated? T.W.

THIS PAGE is, in effect, a forum where engineers may discuss problems without the expense of railroad fares and hotel bills. Just how some readers would debate this question at a round table may be had by somewhat rearrranging their written communications, which the editor has done here.

EDGAR J. KATES, consulting engineer, New York City—This problem is highly interesting and it is unfortunate that more plants ignore the possibilities of cheap oil.

The use of the heavy oil ought to effect a large net saving in a plant where the conditions are so unusually favorable as in this one. The annual capacity factor of 71 per cent is so high that the fuel cost is by far the predominating item of cost. Assuming 11 kw-hr. per gallon, which is reasonable for this capacity factor, the fuel consumption is about 1,275,000 gal. per year, making a difference in cost in favor of the boiler oil of about $24,700. It seems clear that so large an annual saving will well justify the installation of an efficient system for settling, cleaning and preheating the fuel to remove water, dirt and other contamination and prepare the fuel for satisfactory engine performance. This is, of course, predicated upon the assumption that the combustion system of the engines in question is adapted to burning heavy oils when the latter are suitably prepared; there are a number of makes of engines of which this is true.

The use of boiler oil would increase the cost of maintenance. Injection nozzles would need more frequent cleaning. If the engines are four-stroke cycle the exhaust valves would need grinding more often, or if two-stroke the exhaust ports would probably require more cleaning. Piston and cylinder wear would probably be accelerated because of imperfect combustion. However, if the oil were thoroughly cleaned by filters and centrifuge the added maintenance cost would be small in comparison with the annual saving on fuel of about $25,000. Further assurance is given by the high capacity factor, which indicates that the engines run at a good load most of the time. This is conducive to good combustion of the heavy fuel. It is at light load that such fuel tends to give trouble, as the combustion temperature is too low to effect complete burning, and the harmful residuals remain in the cylinders instead of passing off with the exhaust gases.

N. W. STALNAKER, Grinnell, Iowa—Sufficient information is not given in the question for a general answer. Boiler oil can be used in some types of engines without increased maintenance costs and without impairment of reliability, and in other types of engines only at an increase in maintenance. Indeed the majority of American engineers and quite a few of the diesel manufacturers will say that in no case can any great saving be made. However, I have operated four-stroke-cycle air- and mechanical-injection, slow- to medium-speed engines on 12- to 16-deg. Baumé boiler oil with far better results than can possibly be obtained with diesel fuels. In no case was the maintenance found to be greater than $1.50 per horsepower per year. These engines were all operated on loads from 50 to 95 per cent of engine rating for better than 20 hr. per

day. Under these conditions cylinder liner wear was not excessive and the life of the liners was better than 45,000 hr. On the other hand, a four-stroke-cycle air-injection engine of 360 r.p.m. is showing a very high rate of wear during the year that it has been operated on boiler fuel and many other troubles are also present.

If the engines in question are of the slow-speed full-diesel type an attractive saving can be made, provided the project is handled by an engineer with many years' experience in the use of boiler oil. Unless this is the case quite a large sum may be expended in experimental work before satisfactory operation is obtained.

A. Y. TAYLOR, Washington, D. C.—I do not entirely agree with the previous engineers. In my opinion the only type of diesel in which the use of 20-deg. oil is suitable is that in which the atomization of the fuel is aided by compressed air. It is usually found that the heavy oil causes excessive carbonization in mechanical-injection engines, with attendant high temperatures and repair costs. These latter are due to stuck rings and valves, and, in extreme cases, to cracked cylinder heads. The exhaust will not be clear and the efficiency will be poor in these engines, due to the incomplete combustion obtained with such a grade of oil.

If, however, the plant is equipped with diesels capable of running on this fuel, by the installation of heating equipment for the fuel oil and by properly adjusting the fuel-nozzle timing, large savings would result.

For best results the oil should be heated to give a viscosity of 250 sec. Saybolt Universal, although the engines will perform on a somewhat more viscous oil. The equipment required for this would be coils in the fuel-storage tanks and hot-water lines paralleling the fuel piping to the nozzles. These should be arranged so that the hottest water is nearest the nozzles. This equipment, including the hot-water pumps, would cost in the neighborhood of $500 installed.

This type of oil may contain dirt or water and these impurities should be allowed to settle off. Heating to about 140 deg. F. will be necessary to accomplish this.

HERB M. SHORT, McIntosh & Seymour Corp., Chicago, Ill.—Regardless of Mr. Taylor's expressions, my experience in different sections of the United States has shown that nearly any standard air-injection or mechanical injection engine of comparatively recent design will handle fuel oils as heavy as 18 deg. Baumé without heating or treating, except in extremely cold weather. In some sections of the country where extremely low temperatures are expected regularly, and, regardless of location, where such oils as Bunker C are used, it has generally been found necessary to heat the fuel oil to temperatures of 150 to 180 deg. F. to allow it to be transferred through pipes.

Assuming, however, that T. W.'s plant is not in an extremely cold section of the country and that the boiler oil to which he refers is of a Baumé gravity of not less than 18 deg., he may expect his fuel costs to be at least in proportion to the oil prices. Actually, if his engines will handle the boiler oil at all, his net kilowatt-hour output per gallon of oil consumed will be greater with the cheaper oils, effecting a still further reduction in fuel costs. For example, suppose the net average output per gallon of the 30-deg. oil is 10 kw.-hr. This oil weighs approximately 7.29 lb. per gallon, which would mean 0.729 lb. per kilowatt-hour. Fuel oil at 20 deg. Baumé weighs approximately 7.77 lb. per gallon, and at 0.729 lb. per kilowatt-hour the actual output per gallon would be 10.67 kilowatt-hours.

L. R. BAKER, Cleveland, Ohio—There is always danger in making broad statements. For example, the description, "boiler fuel oil" is not very definite, and may range from 24 to 26 deg. Baumé Mid-Continent residual after topping off the light distillates, to Gulf Coast naphthene-base crudes or residuals from the cracking processes, which may range down to 10 deg. Baumé. Some diesel engines will handle the heaviest of these, others will not; but in any case a clarifying system should be installed to remove the foreign matter, dirt, sand or grit.

Heavy fuel oils have fewer heat units to the pound, but as the weight per gallon is increased the total heat units per gallon is greater than with the lighter oils, even after the total quantity of oil has been reduced by removing the solids present.

Most fuel oils are sold, with a flash point guaranteed not less than 190 deg. F., which should be the upward limit on account of fire hazard. Fuel oil 24 to 26 deg. Baumé need only be heated in cold weather, for if clean it will flow through a needle-point orifice.

▼

A Question for Our Readers

WE OPERATE a 100-ton motor-driven ice plant. Condenser make-up and can water is obtained from a drilled well; the summer water temperature is about 45 deg. F. Would we be justified in pumping enough of this water to precool the ammonia. Power costs 3c. per kilowatt-hour and the water must be lifted 270 feet. L.M.L.

Suitable answers from readers, if received promptly, will be paid for when published.

It should not be necessary to start with a light oil, except in very cold weather. Even then, if the heavy oil is hot there will be no difficulty.

MR. SHORT—I take strong exception to the last remark. Where heavy oils are used, it has been found advisable to switch to a lighter oil a few minutes before shutting down a unit. After the unit has been shut down, the heavy oils may be turned back into the lines. As a rule, the heavy oils have high sulphur contents, and if the engine is allowed to stand with the sulphur fumes in the combustion chambers and exhaust manifold the condensate formed on the inside of these parts by the cooling of the metals will form a dilute sulphuric acid which may cause serious corrosion. The use of the lighter fuels during the last few minutes of operation will obviate this possibility, and when the unit is again started up the fuel pumps and lines will be filled with the lighter fuels and any possible troubles that might be encountered in starting on the heavier oils will thereby be eliminated.

MR. TAYLOR—I am in entire agreement with Mr. Short. Even though the sulphur content of the oil did not run over the allowable 1½ per cent, good practice would demand that the engines be both stopped and started on a light non-sulphurous oil or kerosene. This would be absolutely essential if the plant were situated in a cold climate, where the oil would be so viscous as to congeal in winter. If there is any danger of getting oil with a high sulphur content, the air compressor should be piped to the outside so that no sulphur dioxide gases can come in at the compressor.

MR. STALNAKER—Referring to the statement as to starting on the boiler oil, light fuel oil is necessary and is to be used at the start and end of each running period. With such information as is given I cannot estimate just how much of the light fuel oil will be necessary. In any case it will not be more than 1½ per cent of the boiler fuel used; since this fuel will replace almost an equal quantity of boiler fuel the additional cost will be two cents for each gallon of light fuel oil used. A viscosity of 50 to 100 sec. Saybolt Universal seems to be the most satisfactory viscosity for slow- to medium-speed engines, and the heavy boiler fuel oil will reach this viscosity at 200 to 225 deg. F. This is well below the flash point and carbonization point, and since very little of the fuel is heated to this temperature at one time insurance regulations will in no way be affected.

MR. KATES—The boiler oil should, if possible, be heated high enough that its viscosity at the temperature in the injection nozzle is the same as the viscosity of the light oil at the same place. This will tend to make the spraying conditions alike. Some boiler oils froth before their temperature is

raised this much; such oils should be used at lower temperature or else heated under pressure to prevent the evolution of bubbles.

J. J. McDOUGALL, Globe, Ariz.—Probably the opinion of an actual user of heavy oil may be of assistance. From actual experience with a number of diesel plants and under most severe conditions of service, burning boiler fuel oils of 12 to 18 deg. Baumé, I know that a diesel engineer would have little difficulty in saving several thousands of dollars a year by changing to the boiler oil.

The fuel system of the engine and plant must be properly designed and adjusted to handle the heavier fuel; and the engines must be maintained in first class condition. Under any other conditions the actual costs caused by high maintenance and renewal of piston heads, piston rings, valves and cylinder heads, and cylinder wrecked by imperfect and improper combustion, plus the costs due to lost output and capacity, will exceed the saving due to cheap fuel.

A light fuel oil should be used for starting because on starting a cold engine the fuel pump and its system, being full of heavy, sluggish oil, are liable to be damaged; also the combustion spaces will foul due to poor atomization and imperfect combustion. It is a good method to run on light fuel until the engine is heated up and heated heavy oil is being delivered at the pump.

The fuel must be heated to a temperature of 120 to 200 deg. F., depending on the kind of oil and design of fuel pump and fuel valve, or atomizer. It must be hot enough to pass through the filters and screens properly and to arrive at the pump in such a heated condition that the pump can handle it without developing excessive pressure. The temperature must be high enough that the oil passes through the atomizer properly. For average conditions oil at 120 deg. F. works well.

▼

Emergency Natural Gas Supply Stored in Unique Reservoir

A UNIQUE RESERVOIR for the storage of natural gas in anticipation of contingencies is being utilized near Kansas City, Mo.

Realizing that the supply of natural fuel to the city and surrounding areas must not be interrupted for any reason, the Cities Service Company has acquired 4,773 acres of land covering a gas pocket of that size 20 miles from Kansas City. This pocket has been cleaned out and the holes plugged up and a total of 1,138,476,000 cu.ft. of natural gas, enough to serve Kansas City for more than ten days, has been stored here.

The pocket is connected with the main line from Texas. An additional line, about 24 in. in diameter, will connect the pocket with the city

House Committee Studies Patent Law Revision With View to Clarifying Present Situation

TO DISCOVER what revision of the patent, trademark and copyright laws would be helpful from the standpoint of industry and business, the House Committee on patents is now holding hearings. As usual, many bills have been introduced again this session, but Representative Sirovich, new Democratic chairman of the House Committee, has announced that before any specific bills are considered or any further legislation drafted it is his purpose to open the whole subject for discussion that a fundamental understanding may be reached of the problems which have arisen under laws that remain on the statute books substantially as enacted nearly a century ago.

Representative Sirovich has taken over the reins from Representative Vestal, who, as Republican chairman of the committee in the last Congress, sponsored several measures that died a'borning. In the present hearings both private and public interests are invited to suggest legislation without having to talk to any particular bill. Previous measures have been so mutilated before coming out of committee that they did not command the support of any of the advocates of new legislation.

In the conflict of self-interested opinion that has surrounded the patent law, its primary object, that of obtaining disclosure of inventions for the benefit of the public, is almost lost to sight. Pat Pending is sure to get a sound tongue-lashing as the hearings progress. He has been employed to extend indefinitely the period of protection which the law allows inventors as a reward for revealing to the public their ideas for the advancement of art and industry.

The life of a patent from date of issue is seventeen years, but many applicants, after filing their claims, permit them to hang fire, thus obtaining a large measure of protection for a long period before patent is actually granted. In general, this practice would be suppressed by limiting protection accorded by a patent to twenty years from date that application is filed. Amendments proposed by the American Patent Law Association and approved by the American Bar Association provide:

1. That if an applicant fails to put his claims in condition for issuance of patent, or for appeal, within a time limit set by the Commissioner of Patents, they shall be regarded as abandoned:

2. That the Commissioner of Patents may order an application pending three years to be placed in condition for allowance or appeal on thirty days' notice, and shall then take final action. This recommendation was adopted as an alternative to a proposal that patent applications pending three years be thrown open to the public.

In order to erase complications now surrounding proof of invention, an amendment has been proposed that would require an inventor to file application for patents within two years after his discovery. The present provision of the law permitting an inventor to exploit his invention publicly for two years prior to filing application does not indicate when the inventor may have first conceived the idea and has led to interference and contests that run as high as 4,000 a year.

Another recommendation would substitute for the present law on disclaimers legislation providing that judgment or decree holding one or more claims of a patent invalid shall not affect the validity or prejudice any rights under any other claims and shall not affect the validity of or prejudice any rights under the claims held invalid except as to the parties to the suit in which decree is entered. Other recommendations proposed by the bar involve legislation to authorize a single signature to applications, and to lift restrictions on the power of the assignee of a patent to file divisional, continuation, renewal or re-issue applications.

▼

Rock-Island Turbines Have Adjustable Blades

IN THE article "Hydro-Electric Prospects Exceed Expectations," Jan. 5 number, the propeller-type turbines in the Rock Island plant of the Puget Sound Power & Light Company were referred to as being of the fixed-blade type. This was incorrect; they have adjustable blades and are the largest of this type so far installed in the United States. They are rated at 21,000 hp. at 100 r.p.m. under a head of 32 ft. The pitch of the blades can be varied to suit conditions, so that good efficiency can be maintained through a wide range of head. The maximum static head on the plant will be 51 ft. during low water.

The units must be shut down to adjust the position of their runner blades. The actual adjustment of these blades on one runner requires from two to three minutes. The total time required to shut a unit down, change the angle of the runner's vanes, start up again and synchronize has been as low as eight minutes. It is expected that the change in runner-vane position will be required only a few times each year to conform to the seasonal variation in operating head.

▼

IN THE description of the Siemens-Schuckertwerke A.G. high-pressure marine installation, which appeared in *Power*, Dec. 15, 1931, the grains per gallon as given should be divided by 10 to obtain the actual amount of solids in the water.

THE ENGINEER'S BOOKSHELF

Combustion in Engines

THE INTERNAL COMBUSTION ENGINE. *By D. R. Pye, Deputy Director of Scientific Research, British Air Ministry. Published by the Oxford University Press, 114 Fifth Ave., New York City; 1932. Cloth, 6x9 in.; 250 pages; diagrams and tables. Price, $4.*

RECENT DEVELOPMENTS have compelled modern engineers to equip themselves with a certain amount of indispensable theory. It is to meet this new educational and technical demand that Mr. Pye has written the present book. Nor is the general interest in the problem to which attention has just been drawn, confined to a single volume, for it comes before the public as the first of a new series, each number of which is to deal with a different department of technology, though all are to be planned to meet the special demand of the engineer and student of today.

This first book is somewhat misnamed and should properly be entitled "Combustion in Internal-Combustion Engines," since little else is discussed. However, combustion is fully covered and much material heretofore buried in reports has been brought into the light of day. For this reason, engine designers will find the treatise of particular value.

Golden Rule Without Gold

WORLD DEPRESSION TO WORLD PROSPERITY. *By A. G. McGregor, consulting engineer. Published by P. S. King & Son, Ltd., Orchard House, Westminster, London, England; 1931. Cloth 5x7 in.; 118 pages. Price, 5 shillings.*

A PRAISEWORTHY EXAMPLE of the larger interest engineers are taking in world affairs, this book present the views of a prominent metallurgical consultant on the cause of current economic difficulties and their solution.

Use of gold as a monetary standard is fallacious, according to Mr. McGregor, because its value is not fixed, it complicates international trade balances and a "very high degree of intelligence and unselfishness" is required "if periods of unemployment and depression are to be avoided in the nations using it."

Instead, the author would substitute a "sound currency of fixed purchasing power" in each country and the "Golden Rule" plan for international trade settlements, under which balance would be maintained through an "International Clearing House" and "the nation which sells more than it buys—that is, the nation which oversells—would bear the financial strain of its overselling."

Besides furnishing sound money of fixed purchasing power, the government of each nation must assume responsibility for the "smooth functioning of industry." To Mr. McGregor this means that all large producers of standardized products "should be compelled to organize sufficiently under some governmental authority" so that over-production and unfair competition can be eliminated, commodity prices fixed and wages of labor regulated to maintain full employment.

"By extricating itself from the toils of gold, and establishing a currency of constant purchasing power at equitable price levels within its own confines," the author concludes, "each nation would enable natural economic forces to function in automatically casting off depression and bringing about a lasting prosperity for itself and a tranquility with its neighbors only dreamed of in the past."

German Power Handbook

HÜTTE: DES INGENIEURS TASCHENBUCH. *Volume II, 26th edition. Published by Wilhelm Ernst & Sohn, Wilhelmstrasse 90, Berlin W8, Germany; 1931. Cloth, 5x7 in.; 1,196 pages, charts and tables. Price, 17.50 marks.*

IN GERMANY and many other parts of the civilized world, "Hütte" engineering handbooks have been standard sources of technical information for over 75 years. It is a welcome event, therefore, when the carefully prepared, comprehensive data these books contain are brought up to date.

The present book is the 26th edition of Volume II of the series, which covers all phases of science and engineering. This particular volume is devoted to mechanical, power and electrical engineering. It contains sections on machine fabrication and mechanical power transmission; steam generators and prime movers; pumps and compressors; machine tools; materials handling and storage systems; light, lamps and lighting; generators, motors, distribution and transmission equipment, and electric heating.

▼

REFRACTORIES. By F. H. Norton. Published by the McGraw-Hill Book Company, 330 West 42nd St., New York City; 594 pages, 376 illustrations; price $6—A comprehensive treatise on the manufacture, testing and use of refractories, this book aims to aid the producer in manufacturing better refractories and the user to obtain longer service from them.

OHIO COAL INVESTIGATION: PART I —AN ECONOMIC STUDY OF THE USE OF HOCKING VALLEY COAL WITH UNDERFEED STOKER EQUIPMENT. By H. M. Faust. Published as Bulletin No. 63 of the Engineering Experiment Station at Ohio State University, Columbus, Ohio; 57 pages, illustrated; price 50c.—First of a series designed to provide more complete information concerning the performance of Ohio coals, this report covers eleven boilers tests made with Hocking Valley 1½-in. nut and slack coal.

FUEL AND POWER IN LATIN AMERICA. By J. R. Bradley. Published as Trade Promotion Series No. 126 of the Bureau of Foreign and Domestic Commerce. For sale by the Superintendent of Documents, Washington, D. C.; price 25c.—The first comprehensive survey of Latin American fuel and power resources and the extent of their development. It should be of particular interest to United States exporters of power machinery.

HANDBOOK OF INDUSTRIAL ELECTRICITY. By Max Kushlan. Published by the McGraw-Hill Book Company, 330 West 42nd St., New York City; 535 pages, illustrated; price $4.—A non-technical reference book of practical information on electricity as applied in industrial work, for those who are engaged in electrical construction, maintenance, testing, inspection and contracting.

THE SWOPE PLAN—DETAILS, CRITICISMS, ANALYSIS. Published by The Business Bourse, 80 West 40th St., New York City; price $3.50.—A full exposition of the business stabilization program proposed by Gerard Swope, together with a chart which compares the details of eight different economic plans, such as the Swope plan, United States Chamber of Commerce plan, Stuart Chase plan, American Federation of Labor plan, etc.

THE ECONOMIC SIGNIFICANCE OF SPECIFICATIONS FOR MATERIALS. Published by the A.S.T.M., 1315 Spruce St., Philadelphia, Pa.; 46 pages.—Report of a symposium held under the joint auspices of the American Society for Testing Materials and the Western Society of Engineers in Chicago last June.

RECENT PUBLICATIONS of the Cochrane Corporation, 17th St. below Allegheny Ave., North Philadelphia, Pa., include the following reprinted articles: "Removal of Moisture From Steam," by C. E. Joos; "Boiler Feed Water Analyses and Their Interpretations," by J. D. Yoder; and "Hydrogen Ion Determinations in the Steam Plant," by C. E. Joos. An interesting plan for the development of 3,000,000 kw. in combination utility-industrial steam plants is described in the chapters on "Industrial Increment Power" and "Joint Firm Power" of the illustrated brochure recently issued by V. D. Simons, Inc., 435 North Michigan Ave., Chicago, Illinois.

WHAT'S NEW IN PLANT EQUIPMENT

High-Speed Electric Operator for Elevator Doors

ONE OF THE outstanding developments in modern elevator service is the rapidly increasing use of power operators on car and hoistway doors. These applications are increasing on both automatic and car-switch-controlled elevators. Both air and electric operators are used, but present developments are centered to a large degree in the electric designs. A recent development of the electric type

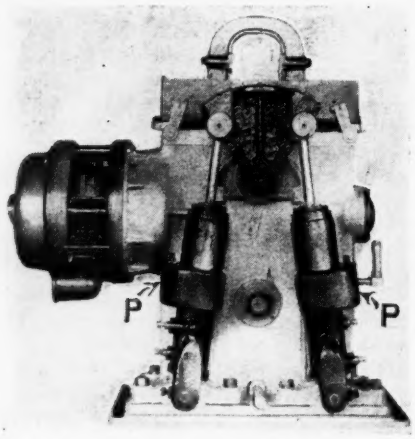


Fig. 1—The dash pots *P* cushion the motion of the door in both directions

has been made available by the Elevator Supplies Company, Hoboken, N. J.

This operator, shown in Figs. 1 and 2, may be applied to car and hoistway doors of various types. It is designed to be mounted on top of the car just above the door.

A standard induction motor provides the power and is supported directly on the case of the double reduction gear arranged to operate in an oil bath. To keep the weight of the unit at a minimum and at the same time provide a substation construction, the reduction gears are housed in an aluminum case. A double-acting check arrangement on the back of the unit consists of two individual dashpots *P*, Fig. 1. One of these dashpots is arranged to check the opening movement of the doors and the other the closing movement. Each dashpot has ample capacity to handle doors of any size and up to approximately five feet of door travel. The checks on the dashpots have two adjustments, so arranged that the doors may be adjusted for cushioning either the closing or opening movement.

The output shaft of the reduction gear is connected to a crank that engages the operating mechanism for the doors, Fig. 2. The lower end of link *L* is fulcrumed on a shaft, at *S*, that supports the car-door operating lever *D*. The slot in the link engages a roller *R* on the end of the crank on the gear shaft. As this crank is moved to the right or the left, depending on the direction of rotation of the motor, the upper end of link *L* also moves to the right or left and imparts the correct motion to the doors to open or close them.

Near the front end of the operating arm on each set of hoistway doors is mounted a rawhide roller. This roller projects slightly beyond the sill line and is engaged by a clutch on the car doors when they are in either opening or closing position, thus causing the simultaneous action of the car and hoistway doors. There is no contact between the roller and the clutch while the car is moving in the hoistway.

The car and hoistway door motion is controlled from the regular car-control handle or may be operated automatically from the elevator control. Full power is applied to accelerate the doors and it is then reduced to a value just sufficient to keep them moving at a uniform speed to the position where the checking action of the dashpots begins. Should the doors be stopped in mid-travel, the reduced power application is removed and they are under control for instant reverse motion. If power fails, due to a fuse

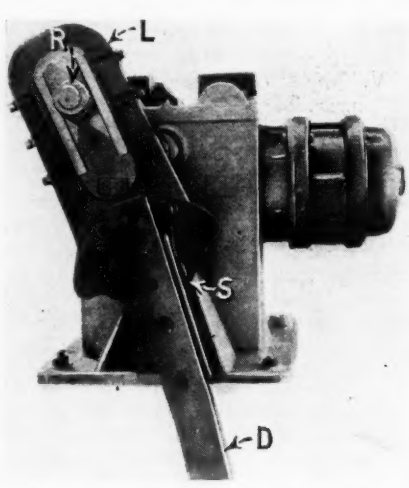
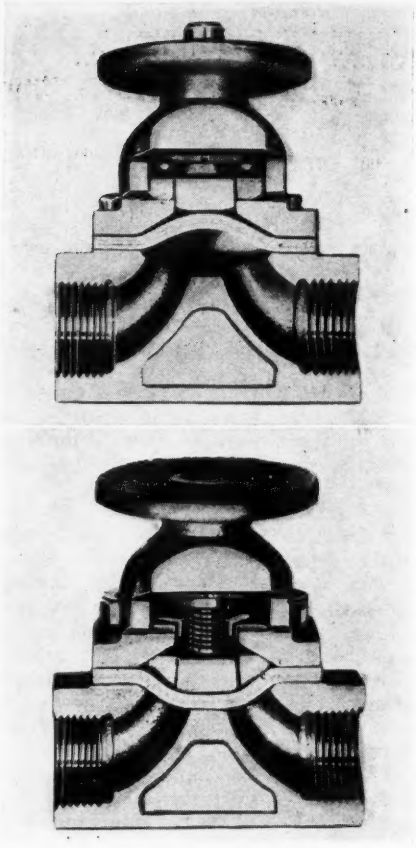


Fig. 2—Lever *D* extends downward to connect to the car doors

blowing or other causes, the doors may be operated by hand.

The operating motor is a standard induction type designed to operate on either 110- or 220-volt 3-phase, 60-cycle current; and the operator may be applied to any type of hoistway or car doors that travels in a horizontal direction.



Diaphragm-type valve in open and closed position

Diaphragm-Type Valve

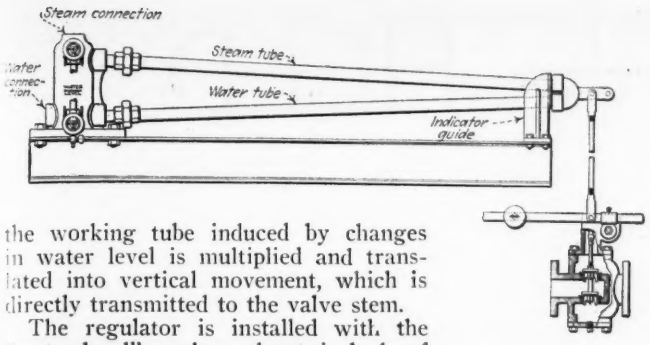
MANUFACTURING and sales rights to a globe valve which has no metal-to-metal seats, no stem packing or stuffing box has been acquired by the Hills McCanna Company, 2349 Nelson St., Chicago, Ill.

In this valve, which is shown in the open and closed positions in the illustration, the diaphragm protects all the working parts from the substances handled. This is claimed to be a particular advantage when handling volatile or corrosive liquids, liquids having gritty solids in suspension, or gases and air.

In the closed position the diaphragm is compressed between the follower attached to the stem and the seat. Corrosion-resisting valves of any commercial material can be furnished. Owing to the design of the valve only the body is made of special metals.

Feed-Water Regulator With Two Thermostatic Elements

THE FEED-WATER REGULATOR illustrated consists, essentially, of two extra-heavy brass expansion tubes connected into a body casting at one end and into a close return-bend at the other. The lower tube is the working element and the upper tube the compensating element. The return bend carries a lug to which the valve linkage is attached; and the expansion and contraction of



Voltz feed-water regulator with two thermostatic elements

the working tube induced by changes in water level is multiplied and translated into vertical movement, which is directly transmitted to the valve stem.

The regulator is installed with the "water-level" mark on the main body of the regulator on the same elevation as the desired boiler water level. When properly installed, the water level in the lower tube is approximately three-quarters of the way out from the gage-glass chamber. In operation, the upper part of the regulator body and the upper tube are, of course, filled with steam, which meets the water in the lower tube.

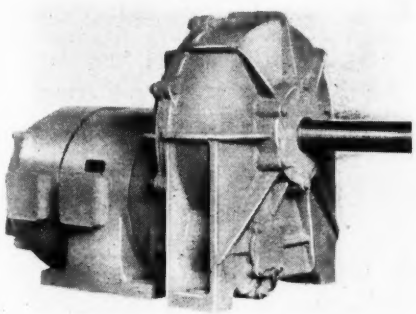
If the rate of steaming increases, the water-level is lowered in the regulator, which brings steam farther down into the upper end of the water tube, causing the tube to expand and thereby raising the lever and opening the feed control valve. When the water level rises to the correct point, reverse action closes the valve. Both brass tubes being exposed to the atmosphere automatically compensates for changes in atmospheric conditions and likewise for variations in steam and water temperatures due to changes in boiler pressure.

The regulator is distributed by J. A. Campbell Company, 1206 South Maple Ave., Los Angeles, Calif.

Motors With Self-Contained Speed Reducer or Speed Increaser

DESIGNED to meet practically every industrial requirement, the line of "Slo-Speed" motors put out by Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles, Calif., is offered in a wide number of combinations, horsepowers and ratings.

The motor and reduction gear form a self-contained unit, with the speed reduction effected by means of totally inclosed single, double and triple helical and herringbone gears. The gears



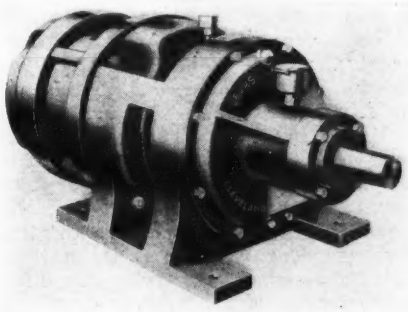
Sterling "Slo-Speed" motors

are of the stub-tooth type, of special chrome nickel alloy and carbon steel. Anti-friction ball and roller bearings are used throughout.

Speed reducer and speed increaser units are available on three-phase, squirrel-cage, slip-ring, high-torque, 2-, 3- or 4-speed motors, special- and single-phase motors. Units can be furnished with the motor shaft extended on the opposite end, thus providing one low- and one high-speed drive, and geared heads can also be put on both ends of motor to provide two slow and different speeds if desired. A range of speed ratios from 3 to 1 to 130 to 1 can be furnished.

Planetary-Type Motorized Speed Reducer

OF THE PLANETARY TYPE and built integral with an electric motor, the speed reducer illustrated is designed particularly for applications where available



Planetary-type reduction gear built integral with motor

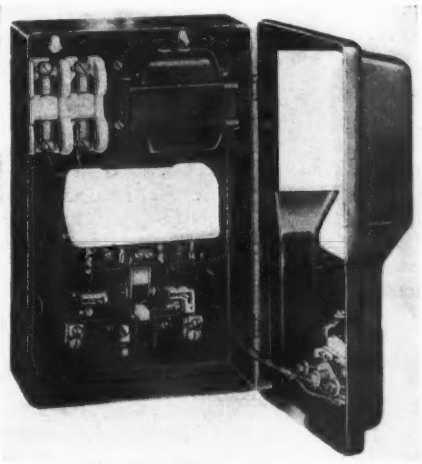
space for the driving mechanism is limited. Due to the simplicity of the planetary design this type of unit gives large reduction in small space.

The housing of the reduction gear is integral with the base, which extends to the centerline of the motor and also provides rigid support to gearing and output shaft which carries the load. No additional loads are imposed on the motor shaft, which is supported by two ball bearings.

This planetary-type motorized speed reducer, put out by Gears & Forgings, Inc., Cleveland, Ohio, is built in thirty-four standard ratios ranging from 4:1 to 240:1 inclusive, and in sizes ranging from ¼ to 30 horsepower.

Across-the-Line Motor Switch With Low-Voltage Control

ALTERNATING-CURRENT across-the-line motor-starting switches, put out by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis., are now available with a step-down control transformer for reducing the control-circuit voltage to 110 volts when the switch is used on 440- or 550-volt circuits. The transformer, which is of the separate-



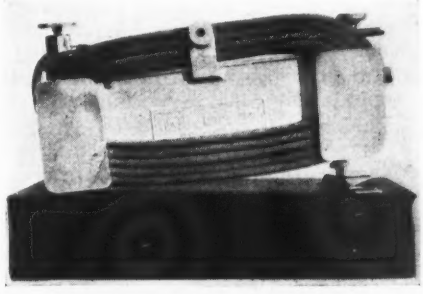
Starting switch with stepdown control transformer

winding type, derives its source of power from the power circuit, and is mounted inside the switch cabinet. The motor is protected against sustained overloads by two Resisto-therm overload relays.

This switch is used where the pilot-control device, such as pressure switch, thermostat or push button, is limited to low-voltage application. Three forms are available, and the maximum rating of the switch is 7½ horsepower.

Improved Pocket Draft Gage

AN IMPROVEMENT to the Hays portable pocket-type draft gage is the equipping of this instrument with a convenient reel for the rubber tubing it carries. Without adding to the length or width of the gage the provision has been made as a convenient means for winding the tubing without kinking. The gage is a product of The Hays Corporation, Michigan City, Ind.



Draft gage with reel for hose

NEWS of the FIELD

Massachusetts and Hudson County (N. J.) Bureaus Report Good Progress in Smoke Abatement Work

FAVORABLE REPORTS of work accomplished in reducing the smoke nuisance during 1931 have just been issued by David A. Chapman, director of the Division of Smoke Inspection of Massachusetts, and by William G. Christy, chief smoke abatement engineer of the Department of Smoke Regulation, Hudson County, N. J.

"As a direct result of the Hudson County smoke abatement campaign fuel users throughout the county saved between $120,000 and $140,000 in 1931," Mr. Christy reports. "This," he says, "is a conservative estimate. It is very possible that the saving was higher but I have based my figures on what I know to be fact."

"What is still more encouraging," he continues, "is that this saving will be multiplied in 1932 due to the fact that as smoke abatement gains so does fuel conservation. Month by month, throughout the past year, there has been less and less smoke and more and more economy. At the end of the year our records showed a decrease in smoke of more than 50 per cent which means that less than half as much fuel was wasted in 1931 than in previous years.

"Smoke abatement has proved a real economical boon to owners of apartment houses, office buildings, industrial plants, oil refineries and railroads, especially those who have made a really conscientious effort to reduce smoke. We have checked with many fuel engineers in plants and on railroads and have found that their fuel consumption records show large savings.

"To bear out the accuracy of our figures are those of David R. Morris, meteorologist of the Central Park Conservatory in New York City. Mr. Morris states that 'sootfall' in 1931, as measured by a delicately accurate instrument in the observatory, was 54 per cent less than in 1930. Prevailing winds were from the West and Southwest, showing a decided improvement in smoke conditions in industrial Hudson County. Suspended fuel particles measured 1.84 tons per cubic mile in 1931 as against 3.97 in 1930."

While no figures showing the amount of savings are quoted in the Massachusetts report, Mr. Chapman states that "there is on file at this office concrete evidence from plant owners appreciating the economies accruing to them from following the suggestions of the division."

"Fundamentally," says Mr. Chapman, "the greatest advance in the elimination of smoke, with subsequent economy for the owner, will be gained by making it impossible for any new plant to be installed or operated or substantially reconstructed until the plans include in the equipment such smoke eliminating devices as have proven to be practical and efficient."

Mr. Chapman calls on the State Legislature to assist in the work by passing laws to limit the amount of smoke emitted in any one hour and to control the fly-ash nuisance from plants burning pulverized coal and the sulphurous fumes from oil-burning installations. He also asks that the engineering personnel of the division be increased.

There were 89 hearings held during the year, sixteen orders issued and two court cases heard, according to the report. More than 700 permits and certificates were issued to builders by the engineering bureau. Observations on stationary stacks totaled 176,515 with 1,266 violations; 42,943 on locomotives with 59 violations; and 3,370 marine observations with 98 violations.

Mr. Chapman points out that 1931 was the first complete year of the division's increased duties under the acts of 1930. He says, "The division has met with splendid cooperation from everybody who has had smoke problems, and it has given everybody in the division a great deal of pleasure to solve these problems, with the violator so heartily assisting in trying to keep within the law."

Wynne Urges Engineers to Check New Boilers for Smoke

ONE OF THE NEXT STEPS in the campaign against smoke would be to require the submission of plans for boiler equipment of all new buildings, Dr. Shirley W. Wynne, Health Commissioner of New York City, stated Jan. 25 at a meeting of the New York and New Jersey Smoke Abatement Board at the headquarters of the New York State Chamber of Commerce.

Pollution of the air, he said, was more dangerous than water pollution because it was easier for people to avoid water than air. He recommended the organization of a voluntary committee of engineers to examine devices for the consumption of fuel without smoke and report to agencies devoted to abatement of the smoke nuisance.

Dr. Harry N. Davis, president of Stevens Institute of Technology, said that surveys made with instruments brought from England indicated that most of the smoke which afflicted New York in the first six months of 1931 came from railroad yards in New Jersey.

House Committee Considers Tax on Power Consumption

IN CONSIDERING new forms of taxation preparatory to drafting a new tax bill, the House Ways and Means Committee has had its attention directed to the possibility of levying a tax on the use of electric power. This suggestion has been made by Representative Crisp of Georgia who ranks next to the chairman on the Democratic side of the committee. It was originally proposed by Mr. Crisp that a tax of one-half cent a kilowatt-hour be assessed and that this should be a consumer's tax. Later the proposal was changed to one calling for a general sales tax of from one to ten per cent applied to electric, gas and telephone bills.

The committee has set aside Feb. 2 as a date to allow those opposed to such taxes to present their testimony.

A.S.T.M. and A.I.M.E. to Discuss Metals at New York

ANOTHER in the series of meetings being held by the members of the American Society for Testing Materials in the New York metropolitan district is planned for Feb. 18 at 8 p.m., when they will gather at the Engineering Societies Building in a joint meeting with the Iron and Steel Division, Institute of Metals Division, and New York Section of the American Institute of Mining and Metallurgical Engineers.

The annual meeting of the A.I.M.E. will be held Feb. 15 to 18 so that this joint meeting of its members and the A.S.T.M. will be on the last day of this annual meeting.

The general theme of the meeting will be on metals. Dr. F. O. Clements, president, A.S.T.M. and technical director, General Motors Research Laboratories, will discuss the subject "Limits of Our Knowledge of the Properties of Metals." H. F. Moore, research pro-

fessor of engineering materials at the University of Illinois, will address the meeting on "Test Results and Service Values of Metals."

In keeping with the general topic of the evening there will be a demonstration of ten different tests of welds given by A. B. Kinzel and W. B. Miller, Union Carbide & Carbon Research Laboratories, and John J. Crowe, Air Reduction Laboratories.

Matthew Sloan Resigns as President of N. Y. Edison

MATTHEW S. SLOAN resigned Jan. 28 as president and director of the New York Edison and affiliated companies of the Consolidated Gas Company group in New York City. "I have business plans for the future, which I am not at liberty to discuss now," said Mr. Sloan in announcing his resignation.

Frank W. Smith, vice-president of the New York Edison Company, was immediately chosen successor to Mr. Sloan in all but the post of trustee of the Consolidated Gas Company.

A graduate of Alabama Polytechnic Institute, Mr. Sloan has devoted practically his entire business life to the public utility industry. He joined the New York Edison Company in 1917 as assistant to John W. Lieb, vice-president, after several years with utilities in the South. Upon the resignation of Nicholas F. Brady in 1919, he became president of the Brooklyn Edison Company and in 1928, when that company entered the new Consolidated Gas set-up, he was made president of the other affiliated companies.

Widely known for his vigor and candor, Mr. Sloan's contributions to the utility field have been numerous. He is a past-president of the National Electric Light Association, the Association of Edison Illuminating Companies and the Empire State Gas & Electric Association.

Columbia University Plans Large Engineering Center

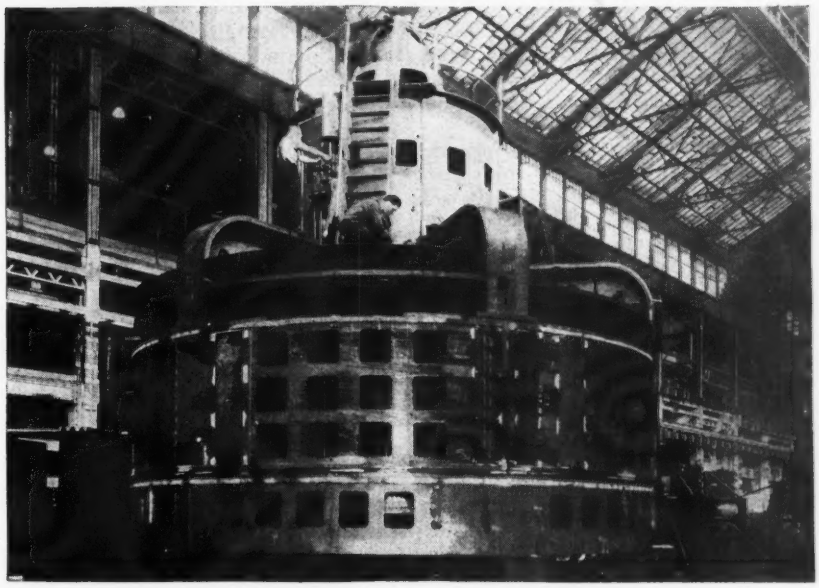
DR. NICHOLAS MURRAY BUTLER, president of Columbia University, has appointed a committee of faculty members and alumni to consider plans for the erection of an engineering center, the estimated cost of which has been placed between $20,000,000 and $25,000,000, according to an announcement in the Jan. 22 issue of the *Columbia Alumni News*.

Comparable in size and equipment to the university's medical center, the proposed engineering center will likewise be apart from the campus on Morningside Heights. Although no date has been set for completion of the project, the committee is already endeavoring to determine a site as near Columbia as possible, yet in a district where the noise of machinery and the fumes and smoke of research laboratories will not annoy nearby residents.

Before the engineering center is constructed, however, it is planned to build additions to the present campus engineering laboratories and lecture halls. The first step, which probably will be taken within a year, will be the construction of a spacious underground room beneath the Engineering Building.

Dr. Butler's appointees include the following members of the faculty: Dr. Frank L. Eidmann, professor of mechanical engineering, chairman of the faculty committee on plans; Dr. Eric R. Jette, professor of metallurgy; Walter A. Curry, professor of electrical engineering; William J. Krefeld, professor of civil engineering, and Dr. Lincoln T. Work, professor of chemical engineering. Alumni committeemen are: Lazarus White, chairman; H. C. Carpenter and Edmund A. Prentis.

77,000-KVA. GENERATOR FOR DIABLO



Of greater capacity than any other water-wheel generators in the Western Hemisphere are the two units now being installed at Diablo Dam, Seattle's third and largest development on the Skagit River. Each is rated at 77,000 kva. at 80 deg. rise, or 66,700 kva. at 60 deg., and operates at 171 r.p.m. One of the generators is shown here being assembled in the shops of the Westinghouse Electric & Manufacturing Company. Its frame measures 26 ft. in diameter

▼ ▼ ▼

Boston Post Office to Have Own Heating Plant

AFTER MANY MONTHS of study and investigation, postal officials of Boston, Mass., have abandoned the idea of purchasing district steam to heat the new Boston Post Office Building, which is among the largest and most complete structures of its kind in the country. Instead, the building will have its own heating plant, and four 3,000-sq.ft. cross-drum boilers have just been ordered from Starkweather & Broadhurst, Inc., engineers and contractors. The boilers will be stoker-fired and will operate at a pressure of 160 pounds.

Work Planned for Over 2,000 Engineers; More Funds Needed

STUDIES of seventeen public projects, requiring the service of more than 2,000 engineers from three to five months, have been completed by the Professional Engineers' Committee on Unemployment, it is announced by Chairman H. de B. Parsons.

All of these projects, Mr. Parsons said, have the endorsement of city and county departments in the New York area, and are greatly needed. A payroll of $5,000 a week to be met out of the committee funds is likely in the near future, according to the announcement.

"The committee," a report made public by Mr. Parsons said, "is responsible for obtaining $113,000 in funds or wages already paid to destitute engineers. Jobs have been found for nearly 600 men. Many of these jobs will continue for many weeks. Many others are of shorter duration."

Though subscriptions received either in cash or in pledges now total about $75,000, the report states, more funds will be needed to enable the committee to stand on its own and carry along the work for at least five months more.

"Out of a total enrollment of 12,800 in the metropolitan sections in the four Founder Societies, we have had contributions from about 1,400," the report continues. "It is estimated that there are 8,000 to 10,000 engineers in the metropolitan district who are not members of the metropolitan sections of the Founder Societies. Every engineer who has a job should contribute to the committee. Every dollar received goes for relief."

Max E. R. Toltz, Prominent Consulting Engineer, Dies

DR. MAX E. R. TOLTZ, consulting engineer and architect of St. Paul, Minn., died on Jan. 11. He was born in Koeslin, Germany, on Sept. 2, 1857.

Dr. Toltz obtained his engineering education at the Royal Academy of Science and Engineering in Berlin. He came to the United States in 1882. Starting as a draftsman with the Great Northern Railway, he spent the first 25

years of his life in this country helping to build and operate railroads in the Northwest. Since 1907 he had been engaged in the private practice of consulting engineering. During the World War he served as supervising engineer in the construction division of the United States Army.

He was one of the organizers and first chairman of the Minnesota Section of the A.S.M.E., later becoming manager and vice-president of the national society. He was a member of the American Society of Civil Engineers, American Institute of Electrical Engineers and Verein Deutscher Ingenieure.

New England Leaders Favor National Economic Council

THAT THE ESTABLISHMENT of some form of national economic council will help New England business and industry to make better progress is the belief of 679 leading New England executives. James W. Hook, of New Haven, Conn., chairman of the Industrial Committee of the New England Council, recently reported from council headquarters this fact as one of the results to date of the committee's survey of the 1932 business policies of New England business leaders.

Of the executives who favored the establishment of a national economic council, 431 considered that such a body should be set up by business and government in cooperation; 232 wished it established by business independently of government; and 16 by government independently of business.

Other measures considered especially conducive to the better progress of business and industry in New England are modification of the anti-trust laws so as to permit greater cooperation in business, and increased services of trade associations to their industries in planning, fact-finding, and promotion of scientific management.

COMING CONVENTIONS

American Society of Mechanical Engineers. Spring meeting at Bigwin Inn, Lake of Bays, Ont., Canada, June 27-July 1. Oil and Gas Power meeting at Pennsylvania State College, June 8-11. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. District meetings at Milwaukee, Wis., March 14-16, and Providence, R. I., May 4-7. Annual summer convention at Cleveland, Ohio, June 20-24. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Boiler Manufacturers Association. Mid-winter meeting at the Hotel Cleveland, Cleveland, Ohio, Feb. 11. Annual convention at the Greenbrier Hotel, White Sulphur Springs, W. Va., May 23-25. Secretary, A. C. Baker, 801 Rockefeller Building, Cleveland, Ohio.

American Society for Testing Materials. Annual meeting at Chalfonte-Haddon Hall, Atlantic City, N. J., June 20-24. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Water Works Association. Annual convention at the Hotel Peabody, Memphis, Tenn., May 2-6. Secretary, Beekman C. Little, 29 West 39th St., New York City.

Engineering Institute of Canada. Annual meeting at the Royal York Hotel, Toronto, Ont., Feb. 3-5. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

National District Heating Association. Annual convention at the William Penn Hotel, Pittsburgh, Pa., June 14-17. Secretary, D. L. Gaskill, Greenville, Ohio.

National Marine Engineers Beneficial Association. Annual convention at the Hotel Jefferson, St. Louis, Mo., Feb. 8-12. Secretary-Treasurer, Albert L. Jones, 313 Machinists' Building, Washington, D. C.

National Electric Light Association. Annual convention in the Atlantic City Auditorium and Convention Hall, Atlantic City, N. J., June 6-10. Secretary, A. Jackson Marshall, 420 Lexington Ave., New York City.

SECTION MEETINGS

A.S.M.E., Schenectady Section. Meeting in Edison Club Hall, Feb. 4 at 8 p.m. Subject: "Air Conditioning in Buildings," A. R. Stevenson, Jr.

A.S.T.M., New York Section. Joint meeting with A.I.M.E. at the engineering Societies Building, Feb. 18 at 8 p.m. Subjects: "Limits of Our Knowledge of the Properties of Metals," F. O. Clements; "Test Results and Service Values of Metals," H. F. Moore; and demonstration of welding tests.

A.I.&S.E.E., Philadelphia Section. Meeting in the Engineers' Club, Feb. 6 at 7 p.m. Subject: "Mercury-Arc Rectifiers for Steel-Mill and Industrial Applications," W. E. Gutzwiller and P. W. Davis.

N.A.P.R.E. First Pacific Coast conference at the Civic Auditorium, San Francisco, Calif., Feb. 17-18. Washington, Oregon, California and Arizona chapters will take part.

Sir Alfred Yarrow, Noted Marine Engineer, Dies

SIR ALFRED YARROW, founder of the famous British shipbuilding firm of Yarrow & Company, Ltd., and designer of the Yarrow boiler, died Jan. 24 at the age of ninety.

Sir Alfred went to work when he was fifteen years old as an apprentice to a firm of marine engineers at Poplar, near London. In 1866 he started his own firm there, and 40 years later moved it to Clyde, home of most of the famous shipyards of Great Britain. Since that time Yarrow & Company have built merchant steamers, destroyers and river boats of exceptionally shallow draught. The Yarrow boiler, generally used by most of the navies of the world, also is manufactured there.

He was credited with having erected the first private telegraph system in England and with having been the first Englishman to use a typewriter. Last year he took up flying as a hobby.

When he was nineteen, Sir Alfred and a young companion built a steam automobile in which they dashed along the highway at 25 miles an hour. One night as they roared down the road with smoke and flames darting from the stack of their strange vehicle they encountered a mounted policeman whose horse was so alarmed that it threw him and broke one of the policeman's legs. That incident led to an act of Parliament under which mechanical road vehicles had to be preceded by a man on foot bearing a red flag.

Obituary

J. R. COWLEY, superintendent of the power plant at Saskatoon, Saskatchewan, passed away recently after a lingering illness at the age of 49. Mr. Cowley has been in charge of the power plant in Saskatoon since 1918. Two years ago when the new government power plant was opened in that city he was placed in charge, which position he held until his death.

ALEXANDER J. WURTS, 70, first faculty member of Carnegie Institute of Technology, died of typhoid fever at his home in Pittsburgh, Pa., Jan. 21. A graduate of Yale University and Stevens Institute of Technology, Professor Wurts was with the Westinghouse Electric & Manufacturing Company for twenty years. Through association with George Westinghouse, Professor Wurts met Andrew Carnegie, and in 1904 was elected the first faculty member of the Carnegie Technical School, which later became Carnegie Institute of Technology. From 1921 to 1924 he was head of the electrical engineering department. Then he became professor of engineering research. A member of the A.I.E.E., Professor Wurts was awarded the John Scott medal of the Franklin Institute for his work on lightning arresters and non-arcing metals.

Personals

FLOYD A. NAGLER, professor of mechanics and hydraulic research at the University of Iowa, and ALBION DAVIS, chief hydraulic engineer of the Union Electric Light & Power Company, St. Louis, were awarded the Norman Medal at the recent annual meeting of the American Society of Civil Engineers, for their paper entitled "Experiments on Discharge Over Spillways and Models, Keokuk Dam." Established in 1872 by the late GEORGE H. NORMAN, this award is presented each year for the most meritorious contribution to engineering by a member of the society.

O. G. THURLOW, vice-president of the Commonwealth & Southern Corporation, under whose direction most of the large hydro-electric projects in the South were designed and constructed, was honored recently by the Alabama Power Company. In recognition of his service to the state and the power industry, the board of directors of the company voted to designate the Lower Tallassee hydro development as Thurlow Dam.

WILLIAM J. REYNOLDS, trustee of the National Association of Power Engineers, is recovering from two serious operations he underwent recently.

D. D. EAMES, since 1919 head of the steam engineering department at the Boston office of Lockwood Greene Engineers, Inc., has opened a consulting engineering office at 410 Commonwealth Ave., Boston, Mass. Mr. Eames was with Lockwood Greene for more than 21 years, during which he was in responsible charge of all power plant design, heating, ventilating, fire protection, special reports and problems of many kinds. He will continue to specialize in this field under his own name.

JASPER H. FISHER has been elected president of the Fisher Governor Company, Marshalltown, Ia., to succeed L. W. BROWNE, who resigned recently. Mr. Fisher has been associated with the company for nineteen years, during which he served as secretary, president and chairman of the board. For the past two years he has resided in California but has returned to Marshalltown to head the company once more.

JOHN A. PHELAN, for the past nine years fuel conservator and engineer inspector for the United States Shipping Board in New York, Boston, Mobile and Galveston, has opened offices in the Commerce Building, Galveston, Texas, as a consultant and research engineer.

THOMAS F. MAHER, formerly vice-president and general manager of the Chapman Valve Manufacturing Company, Indian Orchard, Mass., was recently elected president of the company to succeed ADOLPH W. GILBERT, resigned. EDWIN A. CARTER, chairman of the board, was elected vice-president.

How's Business?

NO INDICATIONS of general increase or decrease in business activity are apparent in the week-to-week records since the beginning of the year. Steel production has shown about the usual seasonal rise under stimulus of increasing automobile production, but steel demand from other sources continues slack. Carloadings and electric power output (1,598,201,000 kw.-hr. for the week ended Jan. 23, according to the N.E.L.A.) have not improved. Construction is being further curtailed by public economy waves which are increasing unemployment. On the whole, evidence that December or January may have marked the turning point is still uncertain. Securities markets are still listless, facing unfavorable earnings reports and lacking evidence of early business improvement. Commodity prices show no sustained strength.—*The Business Week*, Feb. 3.

Business Notes

COMBUSTION ENGINEERING CORPORATION, New York City, announces that J. D. HARRISON, district manager of the Chicago office from 1922 to 1929, has been reappointed to that position, with offices in the Bankers Building, Adams and Clark Sts. Mr. Harrison succeeds Hugh R. Carr, who has been transferred to the sales department of the home office, as manager of stoker sales.

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., announces that the following appointments were made at a recent meeting of the board of directors: F. L. McManus as vice-president in charge of traffic; D. M. Thorpe, vice-president in charge of sales; and L. Tschirky, vice-president and assistant to the president.

LUKENS STEEL COMPANY, Coatesville, Pa., has established at the Mellon Institute of Industrial Research, Pittsburgh, an industrial fellowship whose purpose is the scientific investigation of processes employed in the manufacture of steel plates. Erle G. Hill, specialist in iron and steel technology, has been appointed to the fellowship.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that Chester H. Lang, formerly assistant manager of the publicity department and then comptroller of the budget, has been appointed publicity manager to succeed Martin P. Rice, who retired Dec. 31 after more than 37 years with the company.

LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, announces the appointment of R. D. Eaglesfield as district sales manager for Indianapolis, Ind., with headquarters at 314 East 16th St. Before joining the Lincoln sales force, Mr. Eaglesfield was a manufacturer of motor-driven machinery.

CUNO ENGINEERING CORPORATION, Meriden, Conn., has appointed the Sheffler-Gross Company, 203-11 Drexel Building, Philadelphia, Pa., sales representatives in the Philadelphia district.

GENERAL HEAT & POWER CORPORATION, New York City, announces the removal of its offices from 730 Fifth Ave. to Room 1105, 101 Park Avenue.

Trade Catalogs

DIESEL ENGINES—Full construction details of the new trunk-piston diesel engine, built in capacities of 1,500 to 7,500 hp., are given in an illustrated bulletin just issued by the Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo. The bulletin contains data on plant layouts, initial cost and fixed charges.

WATER TREATMENT — The Permutit Company, 440 Fourth Ave., New York, N. Y., has just published a booklet entitled "Hot Lime Soda Softening." It is profusely illustrated with photographs and diagrams, and contains tabulated data, conversion factors, methods of calculating chemical charges.

ROLLER CHAINS—Catalog No. 525, recently issued by the Jeffrey Manufacturing Company, Columbus, Ohio, presents a fully illustrated description of steel thimble roller chains for elevator, conveyor and chaindrive applications. Tables of specifications, dimensions and prices are included.

BOILER SETTINGS — An extensive treatise on the construction and combustion characteristics of boiler furnaces, made with S-100 "Carbofrax" blocks of the perforated and blank air-cooled type, is contained in Bulletin B-341 just issued by the Bernitz Furnace Appliance Company, 89 Broad St., Boston, Mass. The bulletin is replete with photographs, diagrams, charts, tables.

CONVEYORS—A new catalog entitled "Pneumatic Conveying," has been published by the Brady Conveyors Corporation, 20 West Jackson Blvd., Chicago, Ill. It contains numerous illustrations showing how various loose-flowing bulk materials are unloaded as well as loaded into railroad cars and boats.

UNIT DRIVES—Gearmotors, consisting of speed reducers compactly combined with induction motors, are the subject of Leaflet 20536 recently issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Information on application and operation, details of construction, sizes and speeds are given in the publication.

NEW PLANT CONSTRUCTION

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ark., Hot Springs—E. M. George, Constructing Quartermaster, will soon award contract for construction of new hospital buildings and utilities for Army and Navy General Hospital here. $1,500,000.

Calif., Los Angeles—Ralph's Grocery Co., 926 West 7th St., awarded contract for construction of a 1 story, 80 x 195 ft. market building, including refrigeration rooms, electric refrigeration system, etc., at 7813-21 South Vermont Ave., to S. N. Benjamin, 718 East 16th St. $44,000.

Ill., Bloomington—City, B. S. Rhodes, Mayor, awarded contract for waterworks improvements including replacement of boilers, pumps, oil engines and generators to Fairbanks Morse Co., 217 South 8th St. $143,841.

Ill., Elgin—City having plans prepared for waterworks improvements including well houses, two deep wells, reservoir and high lift pumps. Estimated cost $350,000. Alvord, Burdick & Howson, 20 North Wacker Dr., Chicago, are engineers. Bids taken on two pumps and decision as to successful bidder will be announced shortly.

Ill., Marseilles—U. S. Engineer Office, 333 North Michigan Ave., Chicago,, preparing plans for electrical control apparatus in Brandon Road Lock and Dresdin Island Lock on Illinois River near here. Estimated cost $400,000.

Ill., Rock Island—City plans construction of sewers and sewage pumping station. $20,000. Wallace Treichler, Court House, City Engr. Maturity indefinite.

Ind., Winchester—City awarded contract for sewage treatment plant to R. McCalman, Inc., Danville, Ill., also sewer work and pumping station to John Palmer, Danville. Estimated cost $70,000.

Ia., Grand Junction—City voted $85,000 bonds for construction of a municipal light and power plant. J. W. Watts, City Clerk.

Ia., Ottumwa—John Morrell & Co., will receive bids about March 1 for construction of a 7 story cooling and storage building. Estimated cost $100,000. H. P. Henschien, 59 East Van Buren St., Chicago, is architect and engineer.

Mass., Boston — Hospital Department, plans improvements to power plant at City Hospital, Harrison Ave. Private plans.

Mass., Somerville (Boston P. O.)—First National Stores Inc., Middlesex Ave., awarded contract for a 1 story, 50 x 300 and 35 x 220 ft. warehouse, including salvage building, loading platforms, meat platform, etc., to Turner Construction Co., 137 Newbury St., Boston. Estimated cost $150,000.

Mass., Webster—Webster Ice Co., A. H. McKinstrey, will build a 2 story ice plant on West Main St. Estimated cost $40,000. Work will be done by separate contracts.

Mass., West Boylston — Board of Selectmen, plans construction of a municipal electric light plant. Estimated cost $50,000. Engineer not selected.

Missouri and Wisconsin—North American Co., F. L. Dame, Pres., 60 Broadway, New York, N. Y., program approved by Board of Directors for 1932 includes $19,000,000 for construction by subsidiary companies operating in Missouri, Wisconsin and Middle West.

Mo., St. Louis—Board of Public Service, 208 City Hall, having revised plans prepared for greenhouses, boiler house and heating system, in Forest Park, 5800 Oakland Ave. Private plans.

Mont., Missoula—Northern Pacific R.R. Co., St. Paul, Minn., awarded contract for construction of an ice house including 500 ft. platform, capacity 6,200 tons to Morrison-Knudsen Co., Boise, Idaho. $41,000.

Neb., Ashland — City awarded contract for construction of new pumping station, reservoir and five well houses near Platte River to A. A Dobson Co., 824 First National Bldg., Lincoln. $68,780.

N. J., Jersey City — Mongiello Bros. 625 Communipaw Ave., rejected bids for construction of a 1 story, 100 x 100 ft ice plant Estimated cost $50,000. Christian Ziegler, 26 Journal Sq., is architect

N. Y., Delaware—New York State Electric & Gas Corp., Ithaca, has made application to Public Service Commission for permit to construct electric light plant here.

N. Y., Scarsdale—Board of Erustees Edward H. Jackson, Clk., Village Hall, will soon receive bids for construction of a sewage pumping station on Fenimore Road between Bronx River Parkway and Bronx River. Arthur Boniface. Village Hall, is engineer.

Pa., Pittsburgh—Press C. Dowler Century Bldg, Archt., will receive bids in spring for construction of an 8 story hospital building including power house, etc., at South 20th and Jane Sts., for South Side Hospital. Estimated cost $2,000,000. S S. Goldwater, 1212 5th Ave., New York. Consult. Engr.

Pa., Wilmerding — Pennsylvania Water Co., South Ave., will soon receive bids for improvements to pumping station. Private plans. Joseph Miller in charge of construction

Utah, Murray—City plans an election February 20 to vote $35,000 bonds for construction of municipal hydro-electric plant improvements. Bledsecker & Bledsecker, Murray, are engineers.

Wash., Prosser—Bureau of Reclamation, Department of Interior, Denver, Colo., awarded contract for construction of power canal, power plant and alterations to diversion dam, Kennewick Division, Yakima project near here to General Construction Co., Colman Bldg., Seattle. $131,386.

Wash., Tacoma—City will soon receive bids for additional water supply including four deep wells, pumping station and equipment, etc. Estimated total cost $389,800. W. A. Kunigk, Tacoma, is engineer.

Wis., Marshfield—Steve J. Miller, 101 North Vine St., plans construction of a cold storage plant. Estimated cost $40,000. Engineer not selected.

Wis., Milwaukee—Metropolitan Sewage Commission, will receive bids until February 5 for construction of sewage booster station at Port Washington. Estimated cost $43,000. J. L. Ferebee, Milwaukee, is chief engineer.

Equipment Wanted

Air Compressor — Norfolk, Va. — Bureau of Yards & Docks, Navy Department, Washington, D. C., receiving bids for cross-compound, steam driven air compressor, capable of compressing 5,000 cu.ft. of free air per minute to a gauge pressure of 100 lb. per sq.in.

Air Compressor—Huntington, W. Va.—U. S. Engineer Office, will receive bids until February 9 for steam driven air compressor for U. S. Lock No. 22 on Ohio River.

Generator—Schuyler, Neb.—City will receive bids until February 9 for a 750 kw. turbo generator with condenser, two super-heaters for 250 and 216 hp. boilers. Estimated cost $38,000.

Generating Units, Switchboards, Pumps, etc. —Morgan City, La.—City will receive bids until February 10 for furnishing and installing complete with all accessories two 400 kw. oil engine generating units, switchboards, 1,000 g.p.m. underwrite motor driven pumps, 500 g.p.m. domestic service motor driven pumps, 1,000 and 3,000 g.p.m. low head motor driven pumps, etc.

Moto—Freeburg, Ill.—E. A. Classen, plans to purchase a 5 hp., 60 cycle, 1,750 r.p.m. electric motor.

Pumping Units—Duluth, Minn.—City Council, F. W. Johnson, City Purch. Agt., will receive bids until February 10 for five pumping units for Lakewood pumping station.

Pumping Equipment—Camillus, N. Y.—Board of Trustees, Village of Camillus, O. E. Hayes, Clk., will receive bids until February 11 for furnishing and installing machinery and equipment including pumps and motors, diaphragm sludge pump, electrical devices, etc., in pump house and sewage system.

Pumping Unit, Turbine, Condenser, etc. — Lincoln, Neb.—City Council, T. H. Berg, Clk., will receive bids until February 10 for a steam turbine driven pumping unit including horizontal steam turbine, water condenser, reduction gears, condensate removal pumps, air evactors two domestic pressure pumps, etc. Estimated cost $40,000.

Pumps—Alameda, Calif.—Constructing Quartermaster, Benton Field, Air Depot, will receive bids until February 23 for furnishing and installing one deep well turbine pump complete with electric motor, power connections, control panel, with automatic and manual control, etc.

Pumps—Washington, D. C.—Bureau of Supplies & Accounts, Navy Department, will receive bids until February 16 for sixteen combined condensate pumps, fresh water and circulating and spare parts for Navy Yards, Brooklyn, N. Y., Philadelphia, Pa., Mare Island, Calif., and Puget Sound, Wash. Sch. 7345.

Pumps—Flora, Ill.—City Council, will receive bids until February 12 for pumps, etc., in connection with proposed new water supply system. Estimated cost $150,000.

Industrial Projects

Ind., Marshall—Kraft-Phoenix Cheese Co., 400 Rush St., Chicago, Ill., completed plans for construction of a factory including boiler room, equipment, etc., here. Estimated cost $25,000. W. M. Baird, 400 Rush St., Chicago, is engineer.

Mass., Worcester—Reed & Prince Manufacturing Co., will build a Diesel engine power plant at their factory on Cambridge St. Estimated cost $100,000. Francis J. Sill, Westboro, is consulting engineer.

N. J., Jersey City—Prospect Sash & Door Co., 73 St. Pauls Ave., plans to rebuild factory destroyed by fire. Estimated cost $40,000. Architect not selected.

O., Cleveland—Ohio Chemical & Mfg. Co., 1177 Marquette St., will receive bids about March 1 for alterations to power plant. Mayer & Valentine, Plymouth Bldg., are engineers.

Pa., Franklin—Venango Mfg. Co., subsidiary of Franklin Railway Supply Co., 60 East 42nd St., New York, plans construction of a plant for the manufacture of automobile and locomotive parts at First and Liberty Sts. Private plans.

Pa., Philadelphia—E. I. du Pont de Nemours & Co., du Pont Bldg., Wilmington, Del., awarded contract for construction of a 5 story, 75 x 160 ft. plant for the manufacture of De Lux, a new paint product, at 34th St. and Grays Ferry Ave. here, to Austin Co., 16th and Filbert Sts., Philadelphia. Estimated cost $500,000.

Man., Winnipeg—Dominion Bridge Co., S. W. Campbell, Gen. Mgr., 702 Canada Bldg., completed plans for extensions to plant at Empress St. and Surry Ave. Estimated cost $100,000.

France, Le Havre — French Government, awarded initial contracts for design and construction of primary crude oil distillation equipment in connection with Normandy oil refinery project here to Arthur G. McKee & Co., 2422 Euclid Ave., Cleveland, O., through its associate Schneider & Cie, Paris. $1,000,000. Ultimate total cost $15,000,000.